SCIENTIFIC AMERICAN

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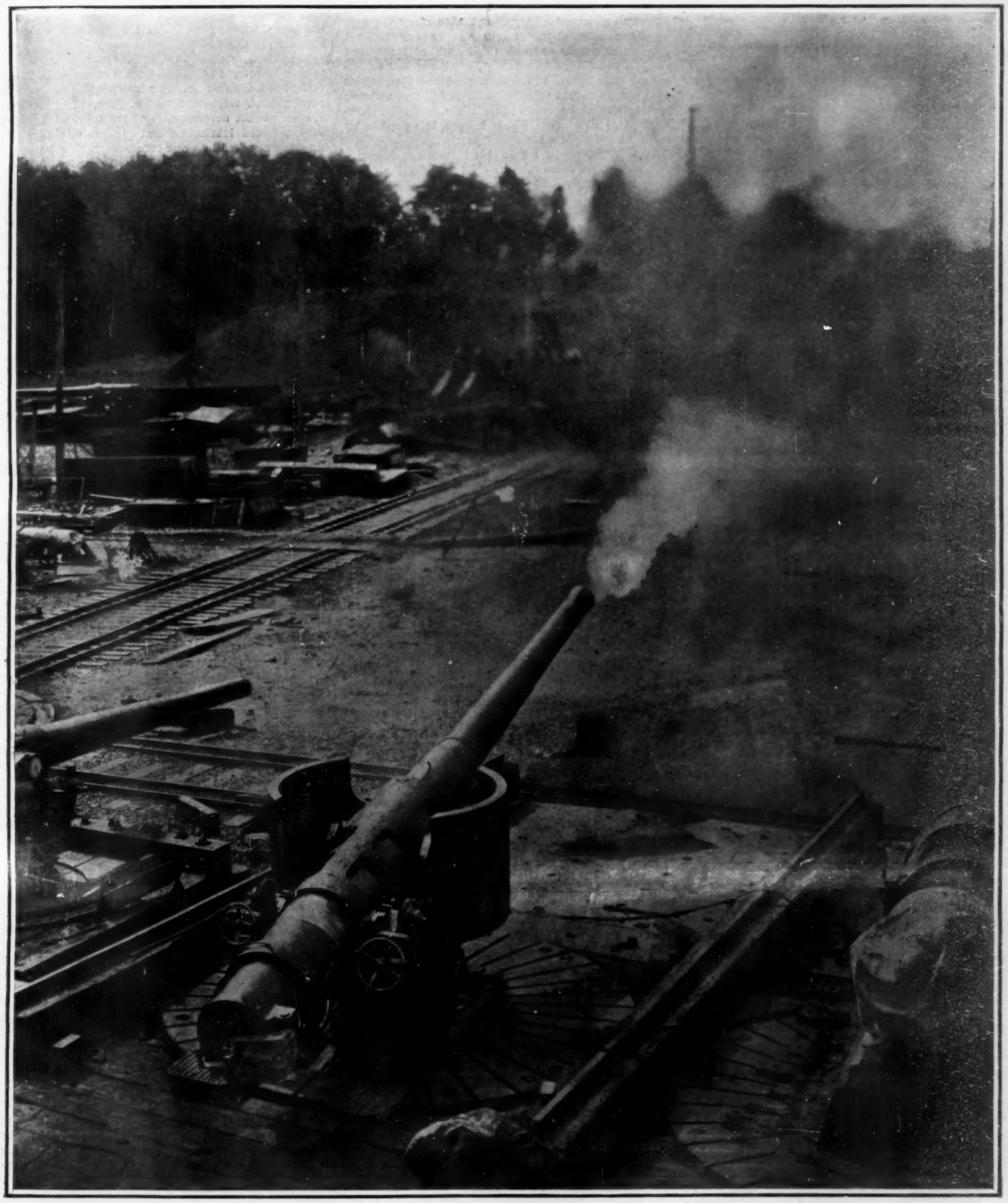

Discharge of an 8-inch navy rifle at Indian Head Naval Proving Ground.

WHAT SMOKELESS POWDER HAS MADE POSSIBLE.—I.—[See page 121.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, FEBRUARY 5th, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LESSONS OF THE PARIS FLOOD.

IT is rather surprising that in all the voluminous descriptions of the Paris flood, which have been published in America, there has been given no complete analysis of the meteorological conditions which have turned the usually gentle and tractable River Seine into a raging torrent, and wrought unbelievable havoc in the far famed and beautiful city of Paris. It seems unlikely that any mere rainfall in the watershed of the Seine could have been sufficient to produce the present enormous flood, and it is probable that a great part, if not the major part of the flood water, is due to sudden melting of the snow in the mountains and on the higher levels.

Apart from the extreme suffering and personal inconvenience resulting from the flood, the most serious aspect of the calamity is the disastrous effects which must surely result from the inundation of the foundations of the city, and the flooding of its labyrinth of subways and sewers by a vast volume of water of great depth, pressure and velocity. It is a fact, well understood by engineers and architects, that foundation material which is perfectly stable in the dry condition, may lose much, if not all, of its supporting power when it becomes saturated; and particularly, if, as in the present case, the ground adjoining the foundation is full of such voids as are represented by subways, sewers, cellars and other excavations. A substratum which will remain stable under normal conditions, may begin to flow or slide when it is saturated; in which case heavy cracks will appear in the superincumbent walls, if indeed the building be not thrown down altogether.

Furthermore, the cabled reports, referring to caving streets, bursting sewers and collapsing subways, indicate that another most destructive action of the water must be actively at work. We refer to the subterranean flow of water under pressure along the face of foundations, subways, sewers and other subterranean masonry work. Where such flow occurs, as for instance along the outside of a sewer, there is liable to be a washing away and displacement of the soil or other material; and where the sewers are filled with water under hydraulic pressure due to a considerable head, such as exists in the flooded district of Paris, it can easily be seen that, having but little strength to resist an outward thrust, they would be easily burst open, particularly if, as suggested, the enclosing soil had been washed away by the flow of water along their outer surface. Only when the floods have subsided and a full examination can be made, will the full measure of the present disaster be ascertained; but the probabilities are that the rebuilding of sub-surface construction will have to be done on an enormous scale.

Unquestionably, one result of the flood will be the undertaking of public works designed to prevent any repetition of the disaster. An obvious plan would be to build a masonry retaining wall, or levee, throughout the whole length of the city and for some distance above it, carrying the work to a height sufficient to prevent any future overflow. So enormous has been the volume of water that has come down, that unless the walls were carried to an inconvenient height, it would be necessary to increase the cross sectional area of the channel either by dredging, which is practicable, or by widening, which because of the great value of the property that would have to be condemned for this purpose would seem to be out of the question.

There can be little doubt that the overflow at Paris has been greatly increased by the presence of so many masonry bridges, each of which embodies several heavy masonry piers that greatly reduce the area of the channel; and if the municipal engineers undertake a sufficient enlargement to absolutely prevent future overflows the question of the obstruction presented by these bridges must surely come up for consideration. Judging from the reports it would seem that not only the piers, but the superstructures of the bridges themselves have served to dam the waters and spill them over the adjoining banks.

If the masonry structures were replaced by suspension bridges or single trusses spanning the entire channel from wall to wall, a great step would be taken toward the prevention of future floods. But would Paris, the beautiful, submit to the removal of so many monuments of her architectural genius as are afforded by the present succession of picturesque stone arch bridges.

THE NEW YORK DEEP TUNNEL WATER SUPPLY.

JUDGED from the standpoint of sound engineering and practical utility the plan to carry the new five hundred million gallon per day Catskill water supply through the length of Manhattan Island in one large deep tunnel, cut through the everlasting rock, is one of the most commendable projects ever brought before this city; and we feel that a strong protest should be made against the attempt to discredit this enterprise, which is now being made by certain more or less interested parties.

It is unfortunately a fact that in this age of sensationalism there is no more fruitful field for the panic-monger and scarehead writer than that of engineering works of great magnitude; for such works deal with the stupendous forces of Nature, developing her latent energies on a grand scale, and holding them for beneficent uses only by the curb and bit of technical knowledge and sound engineering judgment. It is the easiest thing in the world, by a little juggling with figures and a large mis-statement of fact, to write a sensational article (or a series of them for that matter), that will lead the lay public to believe that the project under discussion is ill conceived and pregnant with big disaster. For a notable instance of this it is sufficient to refer to the agitation against the construction of the Panama Canal on the plans which are being so successfully followed. Now, the citizens of New York may rest well assured that the engineers who have staked the city's welfare and their own reputation upon the construction of a huge water-supply tunnel, from one hundred and fifty to two hundred feet below the surface of Manhattan, have not committed themselves to the scheme without the most exhaustive examination of the physical conditions, and the clearest evidence that in economy, durability and public convenience, the tunnel will be a great improvement over the original plan of conveying the water in multitudinous pipes laid near the surface of the ground.

The proposed tunnel, which will vary in diameter from 11 to 16½ feet, will extend from Hill View Reservoir near Yonkers, below the Bronx, the Harlem River and throughout the full length of Manhattan Island; and thence, below the East River, to a terminating point near the Atlantic Avenue Station of the Long Island Railroad. From this point pipe lines near the surface will extend under the Narrows to Staten Island and northeast into Brooklyn.

At the Hill View Reservoir at the north a 300-foot shaft will be sunk, from the bottom of which the great tunnel will be driven to the south. It will be constructed at sufficient depth (generally from 150 to 200 feet) to insure its lying everywhere in rock sufficiently solid to withstand, without leakage, the great internal pressure of the water; and as a further safeguard, it will be lined throughout its length with concrete. The total length of the tunnel will be seventeen and one-half miles, and at 4,000 feet intervals construction shafts will be sunk from the surface. When the job is completed these shafts will serve as up-take shafts, with connections to the surface system of pipe distribution.

The most valuable advantage of the deep tunnel method is that in Lower Manhattan, Brooklyn and Staten Island, the water will be delivered at a greater elevation by about 100 feet than would be possible if the surface pipe lines were used; and water will be available without pumping on office floors up to a height of 260 feet above tide level. This great difference is explained by the fact that the frictional resistance to the flow of the water in the many relatively small surface pipes is largely eliminated by carrying the whole mass of water in one large single conduit. Other advantages are that, since the tunnel can convey as much water as thirty 4-foot pipes, the cost of construction and the annual charges will be about 50 per cent. less; that there will be no interference with subways and sewers, and no opening up of streets during construction or subsequently for repairs; that failure by breakage will be impossible; that there will be a great volume of water at hand in any locality for the control of large conflagrations; and lastly, that by cross-connection of the tunnel with the existing water-supply system, the latter can be safeguarded against any scarcity of supply or other serious emergency.

OUR LATEST AND FINAL RECIPROCATING ENGINE BATTLESHIP.

THERE is no denying the fact that the Engineering Corps of the United States Navy view with no little sentimental regret, and a few of them possibly with some practical apprehension, the passing from our navy of that faithful and highly developed prime mover, the multiple-expansion, reciprocating, marine engine. But if, because of the ever-growing efficiency of the steam turbine, the reciprocating engine is in an advanced stage of obsolescence, it is gratifying to realize that in the United States battleship "Delaware," the last of the reciprocating engine battleships, it has shown that in the most important matter of steam economy, it is perfectly well able to more than hold its own; a fact which is highly gratifying, both to the Bureau of Steam Engineering who made the designs and to the Newport News Shipbuilding Company, the builders of the ship who constructed the engines.

The "Delaware," which is a sister ship to the "North Dakota," is identical with that vessel in everything but motive power. She is driven by two vertical four-cylinder, triple-expansion engines, which embody the very latest developments of the type, with piston valves, forced lubrication and high rotational speed. Steam is supplied by water-tube boilers, running under forced draft, and provided with super-heaters, and feed water heaters.

The contract called for the development of 25,000 maximum horse-power and a speed of 21 knots. In the trials the engines developed a mean horse-power, on five runs over the mile, of 28,576 and a mean speed of 21.44 knots. The maximum horse-power developed for a single mile was 30,000, and the maximum speed 21.98 knots. Interest, naturally, centered on a comparison of the performance of the "Delaware's" piston engines with that of the "North Dakota's" turbines; and although the turbines drove the ship at higher speed, and with a smaller coal consumption per horse-power, the reciprocating engines of the "Delaware" showed a superior efficiency at all speeds in the consumption of steam. Now, while superior fuel economy may be and is often affected by the quality of the coal and the degree of skill of the fireman, and, therefore, may be credited more to the stoke-hole than to the engine room, the steam or water consumption is determined almost entirely by the efficiency of the engine; and it is on this last basis of comparison that the engines of the "Delaware" have made such a remarkably fine showing.

In the 24-hour run at 19 knots the "North Dakota" burned 295 tons of coal, with a water consumption of 15.92 pounds per horse-power per hour, and the "Delaware" 315 tons with a water consumption of 14.52 pounds per horse-power per hour. On the 24-hour run at 12 knots the "North Dakota" burned 105 tons with a water consumption of 23.94 pounds, and the "Delaware" 111 tons with a water consumption of 21.03 pounds per horse-power per hour. The total water consumed per hour by the turbines of the "North Dakota" at 12, 19, and 21 knots respectively was 76,000 pounds, 238,000 pounds and 349,000 pounds. The respective consumption for the "Delaware" for the main engines was 55,000 pounds, 205,000 pounds, and 312,000 pounds. These figures, considered on the score of steam economy, are greatly in favor of the reciprocating engine, and they indicate that the cruising radius of the "Delaware" is considerably larger than that of the "North Dakota."

Why then, it may be asked, is the government committing itself to the steam turbine as the drive for future battleships? The answer is, first, that the "Dakota's" turbines have been greatly improved upon in later models. The number of expansion stages has been increased, and the steam economy has been improved (as shown by recent tests of the Curtis turbine both in England and Germany) until it equals and even exceeds the figures obtained by the best reciprocating marine engine. An even more important consideration is the fact that the steam turbine, with fewer working parts subject to breakdowns, is a far more reliable engine. It can be driven all day long at the highest speed, without incurring any additional risk of failure; whereas when the reciprocating engine is forced to full power for a continuous run, there is always present, even in the best-constructed engines, the risk that some minor but essential part of the mechanism—a rod, a bearing, etc.—may fail and throw the whole engine out of commission.

The French Deputies were presented recently with specimens of the new aluminium coinage with which it is proposed to replace the bronze coins in France. The 10 centimes piece is described as "something between a counter and a trouser button," and is said to be even less attractive in appearance than a nickel coin, and to be "ugly and unhandy." The "sou" is much the same, but, of course, rather smaller, and it is expected that both, if they are adopted, will cause considerable confusion.

ENGINEERING.

An experimental road has been constructed at Truro, which it is claimed has the advantages of being resilient, mud and dust proof, noiseless, and requiring no removal of the old surface. It consists in spiking down on the roadway sheets of expanded steel similar to those so largely used for the reinforcement of concrete, and laying over it a 2-inch depth of ordinary road material treated with coal tar, and rolling well in.

The final plans of the new Argentine dreadnoughts have now been passed. The ships will be called "Rividavia" and "Moreno." They will be of 25,000 tons displacement, and carry twelve 12-inch, twelve 6-inch, and twelve 4-inch guns. The speed will be 22 knots. There will, it is said, be two funnels and two skeleton masts of the new American type. The whole of the twelve big guns will bear on either broadside. The contract for these ships has been awarded to the Fore River Works; and in view of the fact that there was keen competition for this order among the leading shipbuilders of the world, the securing of this contract is a high tribute to American shipbuilding.

A new railroad company has been organized to build a line from Teziutlan, State of Puebla, through the State of Veracruz, to the port of Nautla, says the Mexican Herald. The $2,500,000 gold capital has all been subscribed, and Engineer Leopoldo Villareal, a member of the board of directors, says that the line will develop a region rich in fruit, sugar, coffee, oil, etc., and that the freight on the lemon trade alone will pay the expenses of the road. A branch line will also be operated between Papantla and Misantla.

According to the United Service Gazette, the first airship for the British navy, which is now being built by Vickers, Sons & Maxim, will be the largest vessel of the kind in existence. It will be over 500 feet in length and driven by two motors of 200 horse-power each, which will be capable of driving the vessel at 45 miles an hour in still air. The nominal lifting power will be 20 tons, although its usual load, according to this authority, will not exceed five tons. It will be of the rigid type, as this is considered to be best adapted for naval purposes.

There are over 400 miles of railway now in operation in Guatemala, and various extensions are in prospect. One of these contemplates the building of a line from Zacapa on the Northern Railroad, about 100 miles from the sea, to Santa Ana, on the northwestern frontier of Salvador, where it will connect with the British railway already built, and thereby with the capital of Salvador. Much of the coffee now grown in that republic will thus find an outlet to the Atlantic of which it has long been in need, and it is highly probable that the bulk of the import trade to Salvador will also be conducted along this route.

In his first annual report, Secretary of the Navy Meyer asked for only two battleships and one repair ship. These battleships he recommends should be of the "all-big-gun" type. They will complete the squadron of eight vessels of that type. A repair ship is extremely desirable, in order that the fleet may be made more self-sustaining. Mr. Meyer favors the building of practically all the new vessels under contract with private shipbuilding concerns, not only because these industries should be fostered, but also because the construction is more economical when done by private concerns than at the government navy yards.

There is a bill before Congress providing for a bond issue of $30,000,000 for carrying on the work which is now under construction and contemplated by the United States Reclamation Service. A complete description of this noble project for bringing under cultivation arid and semi-arid regions of the West was given in the Middle West Number of the SCIENTIFIC AMERICAN of December 11th, 1909. It is expected that by the close of the next year about two million acres will have been reclaimed at a cost of $70,000,000. When the system is completed some thirty million acres will have been recovered and opened for settlement.

We have received the report of the Public Service Commission of the First District of the State of New York, which contains some interesting facts. The number of accidents in street and steam railroads within the city of New York was 56,481 in 1908, while in 1909 the number was reduced to 52,618. The number of persons killed decreased from 444 to 325, which is an encouraging decrease. The service rendered by the transportation companies is now better than ever before judged in proportion to the physical conditions and the volume of travel. This is largely due to the orders of the Commission. The minimum of service is continued a much longer period than heretofore, and the rush-train service has been increased. The matter of adequate service is a serious problem; for during each 24 hours, passengers, equal in number to about 85 per cent of the population must be carried. Fully one-third of all the passengers traveling in one direction during the day are carried in two hours out of the twenty-four.

ELECTRICITY.

The United Improvement Association of Boston is urging the electrification of Boston railroad terminals. It is considered very probable that the matter will be taken up by the Massachusetts Legislature. A rough estimate of the cost of electrifying the terminals and suburban lines is placed at between $50,000,000 and $70,000,000.

The Fifth Annual Electrical Show, which was held in Chicago from January 15th to 29th, was unusual for its beauty of decoration. The Coliseum where the exhibition was held was roofed with a canopy of tinsel and ribbons, which were lighted up by means of two batteries of searchlights. The colored lights thrown on the gold and silver tinsel produced an extraordinarily splendid effect.

Electric power is furnished to Helsingöre, Denmark, from Sweden by means of a cable which runs under the narrow sea separating the two countries. The power is generated at a 300-foot fall of the Laga River in Sweden and is conducted to the coast by means of cable, where it connects with a submarine cable three miles long. The transmission of power by means of a submarine cable is quite unusual.

A demonstration of the use of electricity as an anæsthetic was recently made in Hartford, Conn., where a patient was thus anæsthetized while four frozen toes were removed from his foot. For the electrodes two zinc plates were used, one applied to the groin and the other to the ankle. During the operation the patient, who was blindfolded so that he would not witness the work of the surgeons, felt no pain and chatted and talked in a natural manner. When the operation was over he experienced no after effects.

From time to time estimates of the power of a lightning discharge are published which would give one the idea that every discharge represents an enormous current. On this point Prof. Elihu Thompson, lecturing at Princeton University, on "Atmospheric Electricity," recently stated that "we must, however, be cautious not to exaggerate either the current or the potential present in a lightning flash. The current in a flash may at times be only a few amperes or may in a heavier discharge reach perhaps hundreds or approximately in extreme cases some few thousands of amperes. It is doubtful if the potential much exceeds at any time more than a few millions of volts as it is probable that small local breakdowns start the disruptive process which then extends through miles of length."

Following the recent attack on amateur wireless telegraph operators, which has resulted in the presenting of a bill before Congress to limit their activities, the amateurs are banding themselves together to resist any action which would interfere with their liberties. They claim that any experienced operator can pick out from a dozen sets of signals sent at the same time the one which he wishes to hear as each operator has his own characteristic method of sending a message which is as easily recognizable as the voice of one man in a crowd. Also that if the professionals care to go to the expense of installing the necessary apparatus they can cut out all the signals except those they wish to receive. While there are many thousands of amateur stations in this country very few of them are capable of transmitting a message more than a few miles and hence the amateur trouble is not to be gaged by the number of amateur stations but only by the number of those few stations which can transmit to over a hundred or two hundred miles.

The new Egner and Holmstrom microphone transmitter was lately given a test on various long distances starting from Stockholm. Conversation could be heard as far as Paris, which is an exceptionally long distance for telephones on the continent, or about 1,360 miles. The transmitter is based on the use of a light steel cylinder or flat box placed between the diaphragm and the carbon grains, so as to press with the flat bottom of the cylinder on a large surface of the grains. It will carry as high a current as one ampere and is thus exceptionally strong. The tests were carried out by the Swedish telephone administration, using a loop which passed through a distant city and then returned to Stockholm and to a subscriber's instrument. Switching in the old transmitter and the new one allowed a good comparison to be made. Speech could not be heard on the standard system, but it could be well heard when the new transmitter was used on lines such as Stockholm-Helsingborg and return, or 1,920 miles. Tests were also made between Stockholm and Berlin, and at this distance, 780 miles, speech was as clear as on 100 miles of line on the standard system. Good results were had between the city and Cologne, or, 900 miles, after which the coupling was made with Paris (1,360 miles) *via* Frankfort and Hamburg. A local line leading from Stockholm to Sundsvall (350 miles) was added to this, making 1,710 miles in all and speech sent from Sundsvall to Paris could be well heard.

SCIENCE.

During the month of January, 1910, four comets were at one time in the heavens. The first of these is Halley's comet; the second Winnecke's, rediscovered at the Observatory de la Plata on October 31st by Poro; the third, is Daniel's, and the fourth Innes'.

The Austrian Ministry of Public Works is trying to settle upon a place where radium may be sold, and the price to be charged. The question came up when a quantity of ore shipped from Joachimsthal was found to contain no less than one gramme of radium. The price of this small quantity has been fixed at 380 crowns ($77.14) a milligramme. Those who contemplate purchasing radium may have their addresses entered at the Ministry of Public Works in order to receive information as to quantities and current prices of radium.

Dr. E. G. Acheson was presented with the Perkin medal at a recent meeting of the Chemist's Club. In presenting the medal Prof. C. F. Chandler traced the history of the decoration and told how it had been conferred upon Sir William H. Perkin, Dr. J. B. Francis Herreshoff, and Dr. Arno Behr. Dr. Acheson received the medal for discovering entirely new materials suitable for many purposes and now indispensable to the world. The substances with which Dr. Acheson's name is associated are carborundum, deflocculated graphite, and Egyptianized clay.

The New York Aquarium had a greater number of visitors during the year 1909 than ever before, the attendance being 3,803,501, an average of 10,417 a day. These figures show that the Aquarium has a greater patronage by the public than all the other museums of the city, including the Zoological Park, combined, and 1,800,000 more, for the same period, than the New York Hippodrome, which has probably the largest attendance of any theater in the city. These figures are unequaled by those of any other museum in the world of which statistics are available.

The first spectroscopic observations of Halley's comet, made at Meudon by Deslandres and Bernard, reveal clearly-marked discontinuities in the spectrum of the comet. The faint continuous spectrum is crossed by distinctly stronger lines, especially in the ultra-violent region. On December 6th the comet showed a nearly circular nucleus, from which extended two curved rays of feeble brilliancy, but distinct, and resembling in form the antennæ of an insect or the prongs of a two-pronged fork. The direction of these rays was such that it appeared scarcely possible to attribute them solely to the repulsive force of the sun. On the following day these appendages were no longer visible and the general brightness of the comet appeared to be diminished. These first observations show that the comet is already self-luminous and that its light is due partly to incandescent gases.

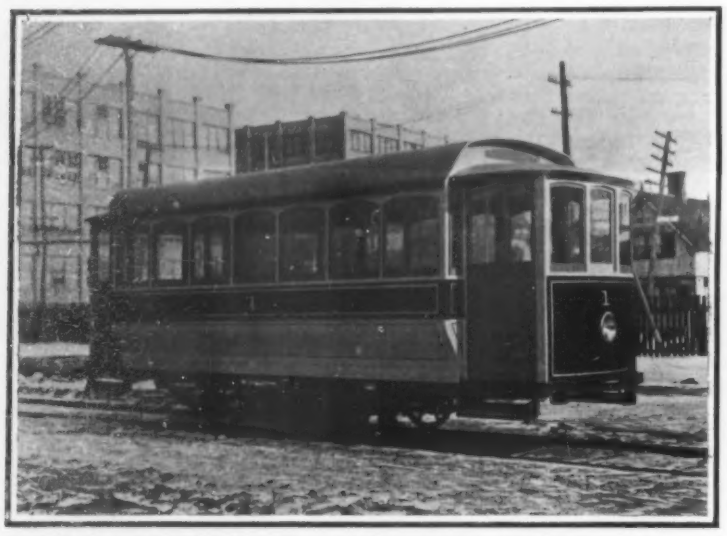
An asteroid, which appears to be a previously unrecorded member of the family, has been discovered by Boinot of the Paris observatory. In examining a photograph made on October 19th Boinot observed a faint linear trace. As the star images on the plate were perfectly round and sharp, it was evident that the trace was either a defect in the photograph or the impression made by a planet. In order to verify the observation, another photograph of the same part of the sky was made on October 23rd. The second plate showed the trace, a little to the southwest of its former position. It was, therefore, certainly due to an asteroid, which appeared to be of the eleventh magnitude. The discovery was immediately reported to the astronomical bureau of Kiel, where the asteroid was provisionally designated by the symbol 1909 J. D. Since the remarkable discoveries made by the Henry brothers the search for asteroids has been carried on almost exclusively by German and American astronomers.

The French journal Le Radium describes a long series of experiments made by Blanc, of Rome, in regard to the presence of thorium in various earths and rocks. The proportions of thorium found, expressed in millionths of the weight of the mineral, were as follows: Roman vegetable earth, 14.5; granite from the Vosges Mountains, 20.7; granite from Lake Maggiore, 31.4; various specimens of syenite, 63.0 to 82.8. The experiments of Joly relating to the rocks of the St. Gothard tunnel, gave the following quantities of thorium (in millionths): 5.10 in the weathered sedimentary rock near Tessin; 11.8 in the schists, and 16.5 in the granite and gneiss of the Finsteraarhorn; but Joly found also similar quantities of uranium and about 1 ten-millionth as much radium. The inference is that thorium exists everywhere, in all rocks, in sea water, etc., and it appears not unlikely that with the aid of sufficiently exact methods, it would be found in all substances. Blanc has calculated the quantity of heat disengaged by the thorium compounds in the rocks and has found it twice as great as the heat produced by the elements of the uranium-radium family in the igneous rocks which were examined by Strutt. Hence it appears that thorium must play a considerable part in the radioactivity of the earth.

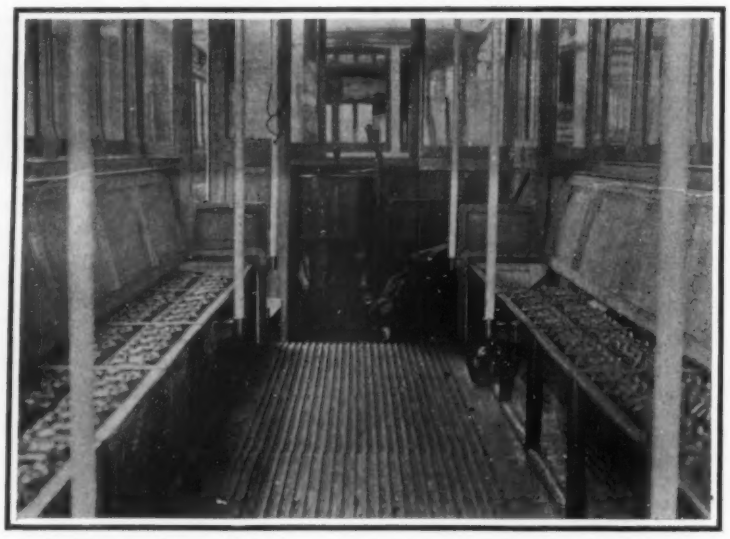
A NEW STORAGE BATTERY STREET CAR

ANOTHER EDISON INVENTION.

The announcement was made about nine years ago that Thomas A. Edison would soon place on the market a storage battery that would be much lighter and of greater capacity than the usual battery and provided with positive and negative elements that would not deteriorate because in place of an acid an alkali would be used for the electrolyte. Much was promised for this battery, and a year or two later it appeared. The positive element consisted of nickel oxide interspersed with layers of graphite and packed in perforated nickel tubes, while the negative element consisted of iron oxide and the electrolyte was potassium hydrate. Both elements were supported in nickeled steel grids. The battery weighed about half that of the usual storage battery of the same capacity. It showed no serious effect when rapidly discharged, and no damage resulted from overcharging. Shortly after the batteries were placed on the market it was found that the graphite became oxidized and interfered with the output. After considerable research it was discovered that chemically pure nickel could be substituted for the graphite and would not become oxidized in use. But soon another difficulty developed. The nickel was packed in tubes of square cross section and these tubes would buckle or bulge outward, permitting the powdered nickel oxide to filter down over the pure nickel layers and insulate them. Then it was determined that a round tube would have to be used which would withstand the pressure of the nickel oxide. The problem of producing such tubes economically was a serious one. They had to be about the size of a lead pencil, namely, quarter of an inch in diameter and four inches long, with the sides finely perforated. A machine was eventually built which made the tubes out of perforated nickel ribbon. The ribbon was wound spirally with the edges of the coils interlocked and fastened together during the coiling process. A vast amount of money was spent in solving this one problem of the battery.



The car weighs but five tons complete and its construction represents a radical departure from common practice.



Interior of the car with the seats raised to show the batteries placed in the steel girders.

A NEW STORAGE BATTERY STREET CAR.

Shortly after the batteries were first put on the market they were withdrawn on account of the defects above enumerated, and about two years ago when the battery was finally completed in its present form a large number were sent out to be tested on auto-

(*Continued on page 132.*)

ARTIFICIAL PRODUCTION OF THE VOICE

BY JACQUES BOYER

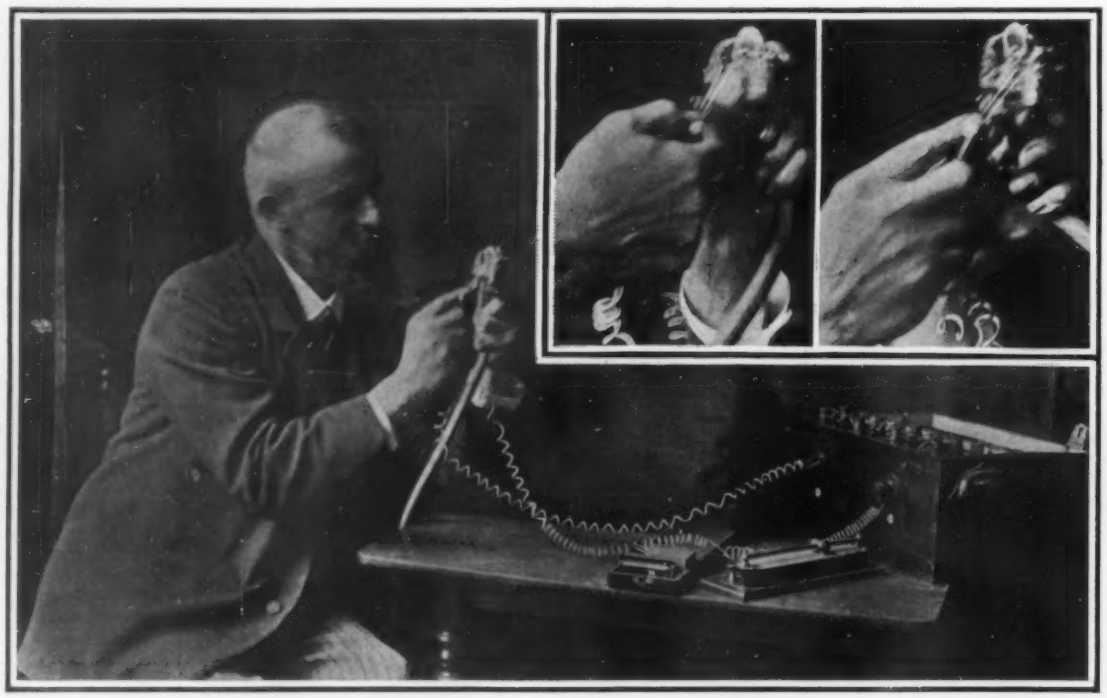
Dr. Marage has succeeded in demonstrating, by numerous experiments, that the voice results from an intermittent vibration of the larynx and the air within it, reinforced by the resonance of the mouth and other cavities situated above the larynx. In a recent communication to the Paris Academy of Sciences, Dr. Marage supplements this demonstration by proving that the larynx alone suffices for the production of these vibrations.

In the first of these later experiments, performed on a living person, Marage succeeded in nullifying the action of the buccal cavity by filling the mouth with 'steut," a substance which is used by dentists for obtaining impressions of the mouth. The steut which filled the mouth was traversed by a rigid tube which connected the larynx with the external atmosphere. Although the resonant cavity of the mouth was thus suppressed, the five laryngian vowel sounds, OO, O, Ah, Ay, and Ee, were enunciated distinctly by the larynx alone.

The investigation was continued by endeavoring to produce vocal sounds from a larynx detached from the body. Muller had already experimented with the dead and isolated larynx, but the sounds which he obtained were quite different from those of the living larynx, and he stretched the vocal cords by applying forces much greater than the muscles of the larynx can exert. These forces, which in some cases exceeded a weight of 2¼ pounds, would certainly have torn out the arytenoid cartilages of a living human larynx. Hence the conditions of Muller's experiments were abnormal.

Marage employed, in his experiments, the larynx of the dog. In order to spare the animal useless suffering, morphine was first administered hypodermically and, three hours later, the dog was put under the influence of chloroform, and the larynx, with five or six rings of the trachea, was excised. A rubber tube of the diameter of the trachea was then connected with the latter by means of a short tube of thin glass, so that a current of air could be forced through the extirpated larynx. The pressure of the air was measured with a very sensitive metallic manometer graduated in millimeters of water pressure. The compressed air was stored in a rubber bag similar to those which are employed for inhalations of oxygen, and was kept at the temperature of 98.6 deg. F. The muscles of the larynx were stimulated by the current of a small induction coil, which was energized by a storage battery, and the sounds

(*Concluded on page 133.*)



ARTIFICIAL PRODUCTION OF THE VOICE.

The left hand and right hand small engravings illustrate, respectively, the form assumed by the larynx in emitting a deep and a high note.

WHAT SMOKELESS POWDER HAS MADE POSSIBLE.—I.

BY ROBERT G. SKERRETT

Except for saluting purposes, where smoke making is a factor in the ceremony, smokeless powder has supplanted the older propellants.

Our biggest battleships could not be given their present powerful armaments had not smokeless powder made it possible to add to the destructive force of our guns while calling for much less weight per unit of energy than formerly.

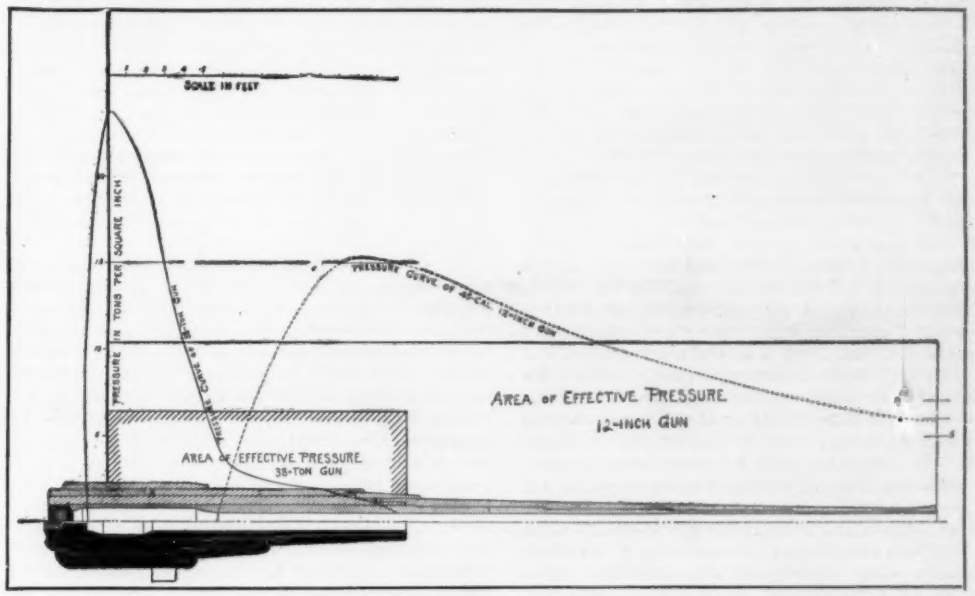
Smokeless powder was first generally used in the French navy at the time of the devolpment of rapid-fire guns to repel the swift torpedo boat. The use of smoky gun powder in those weapons would have blanketed the defensive vessel in a cloud and have given a greater chance of success for the torpedo boat. Thus, a military necessity demanded the change. Once developed, however, smokeless powder became the stepping stone to a revolution in ordnance engineering. This was due in the main to the differences between the physical actions of the old and the new propellants.

Black gun powder has a very dignified antiquity. It is a mechanical mixture of saltpeter, charcoal, and sulphur. Smokeless powder, on the other hand, is a chemical combination in which the atoms bear a different and a far more intimate relation to one another. Common gun powder is a violent explosive and generates its gases with great suddenness. Its grains, however, when burned in a confined space, are only imperfectly consumed, and large volumes of smoke are generated. When used in guns, the products of this combustion give about 40 per cent of propelling gases. These propulsive gases have the double burden of moving the shell and this inert mass of smoke and unburned grains.

Prior to our adoption of smokeless powder, the charge was about half the weight of the projectile—double the quantity of smokeless powder required to give the same ballistic results. Black powder exerts a very great and disproportionate stress upon the breech of the gun. Thence toward the muzzle, the pressure drops suddenly—especially if the grains be small and the mass thus easily inflamed. Our diagram shows graphically the quickness with which the highest pressures are developed and the rapid way in which they fall—the average propulsive force being but a low percentage of the maximum power evolved. It is this average pressure that sends the shot on its destructive errand; and the aim of the ordnance engineer is to have this reasonably high while lowering the crest of the curve of maximum energy.

The first remedy tried was in the form of larger grains, so that, for a given weight of charge, the superficial area at once exposed to the flame should be reduced—the powder instead of going off with a single flash burned more slowly, and the propelling force was better distributed along the bore of the gun. This method led to the making of prismatic grains up to an inch and a half in diameter—regularly and carefully formed. Next, a hole was bored through the middle of these units so that as the consuming flame reduced the outer surface the burning area of the hole was increased, maintaining thus a relative balance of ignited surface and giving a more regular and gradual generation of gas. For a time, this answered. But the gun grew, and the exposed surfaces of the greater powder charge required offered too large an initial burning area, and dangerously high and sudden pressures were produced at the breech of the weapon. Besides this, a big percentage of the grain was blown out of the gun unconsumed. Advance for a time was blocked until the powder makers evolved a "slow-burning" propellant by changing the proportions of some of the ingredients. The purpose of sulphur is to lower the ignition temperature of the powder, and by lessening this element inflammation was momentarily retarded. By increasing the charcoal a greater percentage of moisture was added, and that served as a slowing-up agent in the general combustion of the mixture. The powder thus developed was called "cocoa" because of its color—the consequence of the under-charred charcoal used. In this country, we later called it "brown prismatic." The terms "quick" or "slow-burning" are merely relative. In either case we are dealing with the briefest fractions of a second of time, but measurable intervals that mean everything to the ordnance engineer.

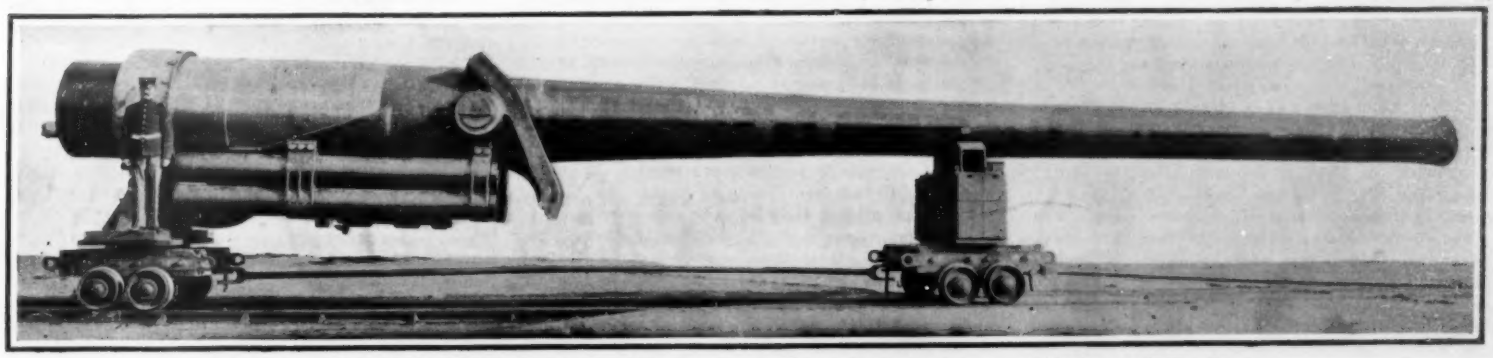
Higher velocities and better ballistics followed. But there was actually more smoke than before, the bores of the guns were quickly fouled, and there still remained a wasteful percentage of unburned grains. Such was the state of the art in this country when we went to war with Spain.


SCALE IN FEET
PRESSURE IN TONS PER SQUARE INCH
PRESSURE CURVE OF 45-CAL. 12-INCH GUN
PRESSURE CURVE OF 35-CAL. 13-INCH GUN
AREA OF EFFECTIVE PRESSURE
12-INCH GUN
AREA OF EFFECTIVE PRESSURE
38-TON GUN

	Armstrong Gun.	U. S. Navy Gun.
Caliber	12.5 inches	12.0 inches
Length of bore	198 inches	546 inches
Weight	38 tons	52.9 tons
Muzzle velocity (per second)	1,400 feet	2,950 feet
Maximum pressure	23.8 tons	15.3 tons

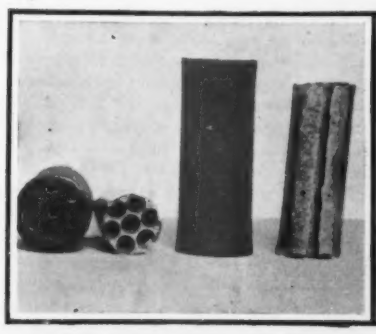
	Armstrong Gun.	U. S. Navy Gun.
Minimum pressure	.6 tons	5.79 tons
Average pressure	6.37 tons	10.40 tons
Powder charge	130 pounds	385 pounds
Weight of projectile	820 pounds	870 pounds

Comparison of construction, powder pressures, etc., of the old Armstrong and the latest 12-inch navy gun.

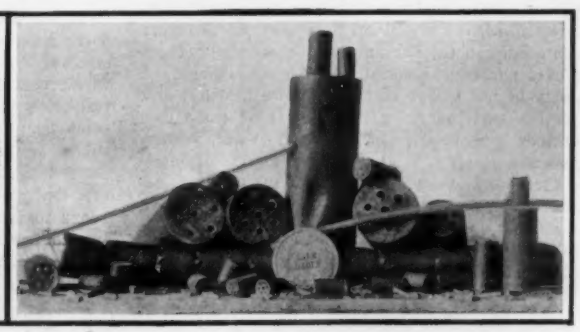


Weight of gun, 63 tons; Weight of shell, 1400 pounds; Powder charge, 365 pounds; Muzzle velocity, 2,600 feet per second; Muzzle energy, 65,667 foot-tons.

THE NEW 14-INCH, 45-CALIBER GUN NOW UNDERGOING TEST FOR THE NAVY.



PARTLY CONSUMED GRAINS OF 12-INCH GUN SMOKELESS POWDER.



SMOKELESS POWDER OF VARIOUS FORMS AND SIZES TO SUIT DIFFERENT CALIBERS OF NAVAL GUNS.

Smokeless powder has quite reversed the task of the ordnance engineer. His aim now is to provide an explosive which can be made to suit the gun rather than to fashion the weapon to meet the violent vagaries of the older propellants. Our present smokeless powder generates a relatively low, regular, and progressive pressure from the instant of ignition up to the time the shot leaves the muzzle of the gun with its maximum velocity. The curve of our big 12-inch rifles shows how much nearer the powder makers have come to solving the problem; but much patient experimenting has yet to be done before the ideal is measurably approached.

The operative cycle of a shot moving along the bore of a gun is exactly opposite to that of a train of cars gaining full speed from a standstill. In the latter case, the engineer knows that he would endanger his couplings—even if he did no other damage—if he opened wide the throttle at the instant of starting. So he begins by just acquiring headway, and then gradually increases the motive energy until the train has reached full speed—a matter of quite several minutes for a fast train and during a distance of a mile or two. The ordnance engineer, on the other hand, can give to his projectile only a flying start by suddenly applying a great and violent pressure; and enough of this propulsive force must follow the shell to the muzzle in order to give the desired maximum velocity. This must be accomplished within a period of not more than one-hundredth of a second of time, and, in our biggest guns, while the shot travels a distance of not more than fifty feet. A few figures will enable us to realize better the task set the ordnance engineer and

the part that smokeless powder plays in the result when measured by the power to strike an appalling blow. The shell leaves the muzzle of one of our latest 12-inch, 45-caliber rifles, with a velocity of 2,950 feet a second—33.52 miles a minute—and has a striking force at that instant equal to a blow of 52,632 foot-tons! A fast express of 350 tons, thundering along at the rapid rate of 98.34 miles an hour, in collision with a standing object, would be able to deal a blow of exactly corresponding magnitude. The gun's missile weighs but 870 pounds, and the charge of powder 335 pounds—such is the power concentrated in our smokeless propellant; and yet so wonderfully regulated is the development of this stupendous energy that the weapon is actually less taxed than the older 12.5-inch rifle dealt with in the diagram, while the present-day gun has far more military value.

Referring to our diagram we see how far smokeless powder has made it possible to improve upon the performance of the Armstrong gun of the "eighties." That gun fired a shell of 820 pounds, used a charge of 130 pounds of black powder, and gave to its shot a muzzle velocity of 1,400 feet a second. At the instant the shot left the gun it had a striking energy of 10,980 foot-tons. To-day, our big 12-inch rifles weighing but forty-odd per cent more than the older weapon, can send their 870-pound armor-piercing shell on an errand of destruction with an initial speed of nearly 3,000 feet a second—delivering at the muzzle a blow nearly five times as great as that of the Armstrong gun. The 38-ton gun, with a powder charge scarcely more than a third of that now used, developed the dangerous maximum pressure of 24 tons to the square inch in the powder chamber. Our big "twelves"—using 365 pounds of smokeless powder—have a maximum chamber pressure in service of not more than 16 tons. This means a reduction of stress upon the breech of the weapon of quite 33 per cent, and yet yielding an average propulsive pressure of something more than 60 per cent greater; all because the present powder burns slower and exerts its driving power for a longer period during the passage of the shell along the bore of the rifle. It is the difference between the shock of a single, sudden, violent impulse and the better-sustained push by which an object may be set in motion and accelerated.

Surely these are truly astonishing strides; and yet so unobtrusively have they been made from year to year that but few of us have realized their extent and their significance in strengthening our powers of defense and of retaliation. Such are the achievements of to-day! What may we not expect to-morrow?

(To be continued.)

A NEW UNITED STATES NAVAL GUN OF GREAT POWER.

Our illustration of the new naval 14-inch gun cannot fail to excite widespread interest among those who are following the trend of development in the United States navy. The piece was constructed at the Midvale Works from plans of the Bureau of Ordnance, and received its finishing touches in the naval gun shops at Washington. It is now undergoing tests at the Indian Head Proving Ground which are giving much satisfaction to the officers of the Bureau.

There seems to be a growing conviction among some of the leading naval powers that, in view of the fact that future engagements will be fought at long ranges at which the remaining energy increases greatly with an increase in the size of the gun, future dreadnoughts will be armed with a piece of larger caliber than twelve inches. Great Britain is building, if she has not already completed, a 13½-inch gun, and our 14-inch piece has been designed and is now being tested, with a view to putting our navy in a position to arm future dreadnoughts entirely with the 14-inch if it should be deemed desirable to do so.

The new weapon, which will be 45 calibers in length (that is to say its length will be 45 times the bore), measures over all 53 feet 6½ inches, and it weighs 63 tons. It fires a projectile of 1,400 pounds weight with a charge of 365 pounds of smokeless powder, and the shell leaves the muzzle of the gun with a velocity of 2,600 feet per second and an energy of 65,687 foot-tons. It will be noticed that the velocity is 350 feet a second less than that of our latest 12-inch gun, but that because of the heavier shell the muzzle energy is greater. The lower velocity has the great advantage that the pressures and temperatures in the bore of the gun will be less, and therefore the erosion will be reduced and the life of the gun before the rifling is so badly worn away as to destroy the accuracy will be considerably longer. The method of construction is generally similar to that shown in the accompanying article entitled "What Smokeless Powder Has Made Possible"; and, except that the powder pressures are lower, the curve of pressure from the powder chamber to the muzzle is approximately the same for the two pieces.

The telescope which is being installed in the Transvaal Observatory will be the second largest in the British Empire. It will be 35 feet long and have an aperture 26 inches in diameter.

The Rockefeller Institute's Work on Infantile Paralysis.

BY JOHN B. HUBER, A.M., M.D.

The psychic machinery in our body is made up of two systems—the cerebro-spinal and the sympathetic; the latter does not here concern us. The cerebro-spinal system is made up of the brain, the spinal cord, and the nerves, which are derived from the cord and extend thence to the muscles, the skin, and the uttermost tissues. The basis of this nervous system is the neurone, composed of a cell-body (gray matter), and its dendrites or fibers (white matter) which emanate from the cell like the roots of a tree. The neurones are sensory and motor; and infantile paralysis is an affection of the motor neurone. The whole is like a telegraph system: The fibers (which make up the nerves) are the telegraph wires; the cell bodies (as grouped in ganglia) are the telegraph stations, communicating by their fibers with the extremities, with one another, and with the main office in the brain cortex.

The sensory ganglia in the spinal cord, to which sensations are telegraphed from the surface of the body, are in the posterior "horns"; thence the sensations are transmitted to the brain cortex, from which in return commands are sent down through the motor ganglia, in the anterior horns of the spinal cord to the muscles working the affected area.

Infantile paralysis is known also to physicians as anterior paliomyelitis (*palios*, gray; *myelis*, marrow—a term applied, no doubt, when the gray matter was erroneously supposed to be marrow; and *itis*, inflammation). So this disease is an inflammation of the anterior horns in the spinal cord—those parts of the cord which are concerned in muscular movements and development; and such a lesion means paralysis, atrophy or degeneration in the particular muscles innervated from the part of the cord involved.

Infantile paralysis is generally an acute disease; and by far the greatest sufferers from it are little children from one to five years of age. Apart from the pathos in this circumstance, we would infer (though not, of course, conclusively) the infectious nature of this form of paralysis. For almost all the acute infections—measles, scarlet fever, whooping cough, and the like—are generally diseases of childhood; adults and the aged seldom contract them, if they have once contracted them in childhood, because the attack in infancy has conferred, in most cases, lifelong immunity upon the individual. Another reason for inferring infectivity in paliomyelitis is its frequently epidemic character; as in the summer of 1907, when nearly the whole Atlantic seaboard was swept, and again in the summer of 1909, when the disease appeared in New York and spread widely throughout the United States and Europe.

In perhaps two-thirds of the cases that have been studied physicians have concluded them to be infectious, though they could not prove this; in the remaining one-third the disease has been attributed to falls, to antecedent maturing fevers, and to hemorrhages into the spinal blood vessels. In the light of our present knowledge, however, it is safe to consider that such falls, fevers and hemorrhages have not been causative of the paliomyelitis, but rather predisposing factors, making the tissues concerned vulnerable to the essential or specific nirus.

The motor neurones in this paralysis become smaller; then they degenerate, liquefy, and finally shrivel up; the fibers emanating from them degenerate and atrophy. This process may go on to complete destruction of these precious elements; or it may be arrested at any stage. If arrested early, repair may ensue and the cells and their fibers regain fairly well their normal condition and function. If, unfortunately, the inflammation goes on, the size and shape of the spinal cord at the points involved are contracted and changed; and in consequence of this the muscles concerned become paralyzed, atrophic, and incapable of their proper function. When recovery does take place these muscles are apt to remain small, perhaps throughout lifetime. These little patients suffer also retarded bone growth, deformity of the joints involved, sometimes lateral curvature of the spine, sluggish circulation, and impaired nutrition.

Such an illness begins suddenly with a high temperature and all the symptoms accompanying a fever; there is a pain in the back and limbs; suddenly there supervenes paralysis, generally in the leg muscles. A child may be put to bed seemingly quite healthy; and may in the early morning manifest these sufferings. The outlook is generally good as to life itself, yet the severity and fatality of the disease, as in all infections, fluctuate widely; and taking it all in all, paliomyelitis is sufficiently disastrous to give medical men much anxiety, as it should give the community in general grave concern.

As intimated, the infectious nature of paliomyelitis has been rather assumed than proved; it would now seem that complete demonstration of infectivity will presently be forthcoming. We may then entertain the confident hope of a preventive and immunizing agent against infantile paralysis akin to that which has practically eliminated smallpox from human experience. Early in 1909 two German experimenters, Landsteiner and Popper, successfully inoculated two monkeys with the spinal cords taken from two fatal human cases of paliomyelitis. In both the monkeys lesions of the spinal cord were on autopsy found similar to those in man.

In September of 1909 Dr. Simon Flexner and his colleague, Dr. Paul A. Lewis, of the Rockefeller Institute, in New York city, obtained the cords of two children that had unfortunately died of paliomyelitis, in which cords the anterior horns exhibited the characteristic grass and microscopic appearances. Transmission was then made to monkeys. After ether anesthesia inoculation was made in the brain of these simians through a small trephine opening. The injected material consisted first of emulsions in salt solution of the two human cords; and later of emulsions of the spinal cords of the monkeys that had developed paralysis after injection of the first emulsion, that from the human cords. The spinal cords in six series of monkeys thus inoculated showed without exception lesions similar to those of human paliomyelitis.

Now, a single successful inoculation with human virus resulting in experimental paliomyelitis could not establish the scientific case here set forth, because the result might have been due to a transferred toxic body; but in the experiments of Flexner and Lewis the transfer of the active agency of epidemic infantile paralysis was regularly successful. In one series of seven monkeys the first inoculation was of human virus; the other monkeys were successively inoculated each with the virus from the cord or the cortex of its predecessor, the disease regularly resulting. Hence, by these and other equally conclusive experiments, one cannot doubt the infectious nature of paliomyelitis.

Again, later injections were made, not only in the brain of monkeys but also into the abdominal cavity, the blood vessels, into nerve substance (as in the sciatic) of these animals. Nor "can it yet be affirmed that still other avenues of infection (as the skin, the organs of respiration or the digestive tract) do not exist, for the entrance of the virus into the central nervous system."

But now as to the nature of this virus which is responsible for infantile paralysis. It is at present invisible under the microscope. Flexner and Lewis, after most exhaustive search, have found that it is neither a bacterium nor a protozoon, which parasites have been isolated as pathogenic of most of the infectious diseases. The virus of infantile paralysis—its infecting agent—is of the same nature as that of smallpox; it belongs to the class of the minute and filterable viruses that have thus far not been demonstrated with certainty. Nevertheless, although the smallpox virus still remains invisible to us, for a century past a vaccine has been evolved from it by which we have practically banished this dreadful disease from the face of the earth; there should then be no reason in science why a vaccine or an immunizing agent against paliomyelitis should not now in good time be forthcoming.

By the way, did the reader note in this paper the phrase "after ether anesthesia?" It means that the monkeys suffered no torture during these experiments, so beneficent in their trend for humankind. Let us congratulate ourselves that infantile paralysis is another added to the long list of dreadful diseases for which a remedy is being found through animal experimentation, which could otherwise never have been evolved.

An Electro-pneumatic Conveyer System for Libraries.

An electro-pneumatic system is used in the Berlin royal library for carrying out the distribution of books to the readers. Upon this system the reader fills out a blank containing the name of the desired book, and upon this blank an employee writes an exact indication of the place where such volume is to be found. The bulletin is then sent by pneumatic tube to the central office. This office is directly connected by elevators with the different stories of the building. These elevators are of small size and are operated electrically on a push-button system. Besides, there is a large elevator running through all the floors for transporting persons and books. A set of pneumatic tubes also run from the central office to the different floors which contain the books. The employee of the central office who receives the reader's bulletin sends the same by pneumatic tube to the proper floor, and on this floor the attendants read the sheet and bring the desired books to the elevator which takes them to the central office. This latter office then sends the books to the point from which the bulletin was sent in the first place, either in the main reading room or any other of the rooms of the library.

The production of mercury at the Almaden mines, Spain, was 1,017,023 kilos, or 29,472 flasks, in 1908. At Micares it was 50,685 kilos.

Correspondence.

THE GYROSCOPE AS A CLOCK.

To the Editor of the SCIENTIFIC AMERICAN:

In regard to Mr. Baker's item in the January 1st number relating to the gyroscope not maintaining its position relative to the earth, but relative to a fixed point in space, if this be true, the gyroscope, operated by a small motor and set on a balanced pivot, would make an excellent timepiece, although slightly different from those in present use, make only one revolution in 24 hours. The clock would of course have to be set with the axis north and south, so the gyroscope would (apparently) rotate from west to east. It could also be geared so as to denote the minutes and seconds, and would be absolutely accurate, with the exception of the slight friction which would have the effect of slowing the clock a trifle.

It occurs to me also that the same principle might be made use of in maintaining the position of astronomical telescopes, if the vibration could be overcome, instead of the mechanical, clockwork devices now in use.

To anyone who has the inclination to experiment in this way, a timepiece of this character would make an interesting toy, and could be very cheaply constructed. An ordinary toy electric motor should serve the purpose of a gyroscope. CARL OFSTHUN.

Edmonton, Alberta.

WHY DOES A WATCH-SPRING BREAK?

To the Editor of the SCIENTIFIC AMERICAN:

Why does a watch spring break after being in use quite a while? If not strong enough, why did it not break at the very beginning?

Such is the question propounded by the Editors of the SCIENTIFIC AMERICAN.

Let us suppose a strip of iron to be fastened at one end, the other end being free. If we bend it a little and then let it go it will return to its place after vibrating a certain length of time. It may do the same again and again, when we bend it more and more until finally after being bent beyond what is called the limit of elasticity, it will be permanently deformed. Its molecules have then assumed a difficult position in regard to each other from that they had before.

If we keep on bending it still more it will finally break in two at the point where the strain is greatest or where a defect may exist.

Now let us try a good steel spring. Here we find no deformation appreciable. When we bend it beyond its strength, it snaps at once. At least it appears to be so. The probability is, however, that a permanent bending takes place first but at a point so near the breaking point that the difference escapes our observation entirely.

Passing to the other extreme we will take a strip of lead. There is then almost no elasticity, a very slight bending will deform the piece; but on the other hand, it will take a considerable amount of bending or twisting to break it.

So much for the immediate effects of bending or otherwise straining any given material. But now the question arises, what might be the effect of a strain not quite sufficient to produce an immediate deformation, but applied during a long time?

I can give here an example that I have often the occasion to verify. Take a piece of tin and a piece of zinc (in sheet) of the same size, bend them to some extent and fasten them. Two weeks later release them. The tin will return immediately to its former shape while the zinc will remain bent just as it was fastened.

Or take a piece of tar and put it on the table. It will keep its shape, and even stand quite a pressure without deformation or breaking down. Nevertheless, in the course of a few days its molecules will have yielded to such an extent that the piece of tar has not even been able to stand its own weight, and has spread over the table.

Now, what has taken place with the zinc or the tar undoubtedly occurs with the other materials within certain limits; at least it seems to me so. The piece of iron kept bent near the point of immediate deformation, must in a sufficient time yield and be deformed. The watch spring, or other steel spring, kept bent not quite enough to break must in course of time break up. The continued tension of the molecules must have a tendency to displace them, and finally causes them to yield.

We have an immense amount of information as to the immediate deformation or breaking of materials of all kinds under stresses applied at once or during a short time, but only very little concerning the effects of stresses applied during a long time. Several suspension cables or bridge steel members have given way after years of service. The general opinion among engineers is that the breaking was due to the vibrations caused by the travel over the bridges. These vibrations caused the molecules of the steel or iron to assume a crystalline structure instead of the original fibrous disposition.

It is said that a watch spring is more liable to break during warm than during cold weather. I am very much tempted to question the correctness of that opinion. However it may be so to some extent at least.

In the first place, as a general rule the strength of all metals decreases with an increase of temperature. Between the ordinary limits to which a watch is exposed, the difference is insignificant. But it is not so as to the expansion of volume. The diameter of the barrel changes but very little, but the spring, being very long, expands out of all proportion. In fact the increase of length of the spring is about twenty-five times the increase of size of the barrel.

That is the equivalent of placing the spring in a smaller barrel and increasing its tension and liability of breakage in proportion. ADRIAN GETAZ.

Knoxville, Tenn.

SAFETY IN MINES.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 4th, 1909, in an editorial discussion of the Cherry mine disaster you state, "the flames reached the dust-covered pine timbers of the structural work." This leads to a suggestion that the structural work in coal and other mines should not be made up of pine or other timber at all, but of iron or steel. Also, from another part of your discussion I conclude that ventilating shafts should be distinct from the hoisting shafts.

In fact, the whole subject of protection to the miners should be studied out by scientific mining experts. The duty to protect the workmen rests as moral duty on the owners and operators of the mines, and this moral duty is in need of legal enforcement by appropriate statutes State and federal. The men are clearly entitled to protection, and protection would in the long run pay in dollars as well as lives.

The whole subject of protection from preventable disasters—and most of them are preventable, as is generally discovered after the event—needs to be made the subject of expert scientific study. The loss of life and limb due to accidents in mines, in railways, and to burning factories, theaters, school houses and hotels is appallingly great; the more so when much of it, most of it, is clearly preventable. But right here it must be emphasized that too much reliance is had on mechanical signal systems such as block signals on railways and the like. No mechanical system can obviate the need of supplementary personal human vigilance. There must be still the human watchman to supplement the mechanical system. Mechanical systems have their advantages—the advantages of automatism. But automatism needs the aid of human intelligence and vigilance. There is too little value placed on human life—the lives of workmen, of travelers, of the spectators at the play, of the children in the great crowded school houses. The man who sees his loved ones start on a journey is likely never to see them again, or at best (or worst) their charred, almost unidentifiable remains. Or if they live, it is to be maimed, disfigured cripples. Or the man himself may be stricken in his prime—the untimely victim of a lack of care or of undervaluation of human life. Or the president of the railway system—as has happened more than once in the last decade—may himself become the victim of his own neglect and may ride to death in his palatial special.

The whole matter of accidents is in a condition unworthy of the intelligence of the country. For one thing, there is lack of constant inspection—eternal inspection, day and night. There seems to be an unwarranted confidence in wood, iron, and steel; a gratuitous assumption that accidents are not likely to happen. The proper, wiser assumption is that they are sure to happen unless forestalled. They certainly do happen. But somehow they do not seem to be taken into serious account. The plans for running railways, mines, and factories leave the certainty of accidents too much out of consideration, as if they were mere "sports" of Nature, mere chances, whereas they are the certain and inevitable and hence preventable results of well-known factors—factors of wear and tear, factors of growing structural weakness in timbers and steel, factors of ever possible congruity of unfavorable circumstances, the incidental coming together of combustible elements, etc.

In hotels it must be assumed that fires are likely to happen at any or all times, and there is need of the eternal vigilance of a sufficient number of trained brains to keep the whole area of danger under intelligent surveillance. Mechanical appliances should not be regarded as a substitute for these living inspectors, but merely aids. For the automatic system has a canny, unmechanical way of getting "out of fix" at the worst possible time. Indeed it can be depended on to do this very thing. These observations apply to railways, mines, and factories. It is not sufficient to have a jury determine whose negligence caused the accident or to say that it was due to some imperfection in the automatic signals. Prevention is the thing. Think what horrible deaths—deaths of scalding, burning, crushing, maiming—American men, women, children and babes are dying almost hourly. The sickening scene is familiar—the "unlooked-for" accident—the sending for the nearest village or town surgeons, the "carting away," the "shoveling up" of the mangled remains, the horrible identification of charred remains by some jewel or scrap of a shoe or fragment of apparel. Prevention is the thing, through expert scientific study and adequate inspection. The subject is of enough importance to warrant it being taken up in the great universities and technical schools, so that men could be trained by proper study and practice to take charge of the important work of saving life by preventing accidents. It would be a noble and useful work, if achieved—and it can be achieved. Railroads or railways systems should have a department with a trained corps of men to cope with these conditions out of which accidents arise. At its head a competent man, not to operate trains, but to remove the dangers of accidental death sure to arise when all are bent on running the trains on schedule (as now) and no one is thinking particularly of the human lives entrusted to the railways system; these dangers would be greatly minimized if the right steps are taken. There is a railway west of the Mississippi River that has been operated for several decades, and it enjoys this unenviable distinction: The road has never caused a single human death. I have heard also of a steamship line that has never lost a passenger's life. This shows what is possible. If these conditions were general, how much happier everybody would be. E. L. BLACKSHEAR,

Fellow American Association for the Advancement of Science.

Prairie View, Tex.

Ephemerides of Innes' Comet.

In order to determine early positions of Comet 1910 *a* on photographic plates, the following ephemeris has been computed by Prof. O. C. Wendell from Kobald's element, given in H. B. 383:

EPHEMERIS.

G. M. T.		R. A.		Dec.		Log. 12.	Log. Δ
	h.	h.	m.	Deg.	M.		
1909, November	29.5	14	58	+ 42	17	0.1567	0.1774
December	9.5	15	38	+ 37	2	0.0874	0.1118
December	19.5	16	33	+ 29	29	9.9987	0.0423
December	29.5	17	15	+ 17	46	9.8701	9.9752
1910, January	8.5	18	18	− 0	31	9.6575	9 9373

From the same elements, Mr. F. E. Seagrave has computed the positions given below:

EPHEMERIS.

G. M. T.	h.	°	R. A.		Dec.		Log. 12.	Log. Δ
1910, February	3.0		22	6	+ 13	50	9.8310	0.0818
February	7.0		22	23	+ 18	59	9.8967	0.1100
February	11.0		22	39	+ 23	13	9.9503	0.1382
February	15.0		22	55	+ 26	49	9.9856	0.1657
February	19.0		23	6	+ 25	54	0.0049	0.1921
February	23.0		23	19	+ 22	58	0.0098	0.2174

The Current Supplement.

The great bridge over the Red River in Indo-China is the subject of an article which opens the Current Supplement No. 1779. Mr. Richards explains some principles in design of friction clutches. A new valve-gear for gas engines is described and illustrated. An automobile chart has been invented by Mr. Joseph J. Jones which serves the functions of a mechanical sign post. Briefly, the invention is a revolving card which tells the driver or any one in a car exactly where he happens to be upon a road. An article on the German "Dreadnoughts" of the "Nassau" type is published. A. Lottermoser discusses the present state of physical chemistry in colloids. Dr. G. Hudson-Makuen writes on stammering and gives some suggestions as to modern methods of remedy. J. T. Cunningham writes on transformations and migrations of eels. Most of us have probably never heard of Nicole Oresme; yet he was the forerunner of Copernicus. Prof. Pierre Durham does credit to his work in an appreciative article. A very exhaustive article on the Paris tunnels will be found in the SUPPLEMENT, an article of peculiar interest in view of the recent inundation of the French capital.

The depth of the water in the middle of the Berlin-Stettin Canal will be 3 meters (9.84 feet), and the breadth at the surface in ordinary soil 33 meters (108.24 feet). In soft, peaty ground it will be from 37 meters to 38 meters (121.4 to 124.6 feet). For a distance of 16 miles the bed and banks of the canal will have to be puddled with clay, the surface of the canal there being above the water level of the surrounding country. At one point the canal crosses the valley of the river by an embankment provided with a culvert 160- meters in length. The eleven locks for the descent into the Oder Valley are begun. One of them has a fall of 9 meters (29.52 feet). The question of building a lift besides the series of locks has not yet been decided. The 37 canal bridges are all to be built of steel.

CLEARING SNOW FROM RAILWAY TRACKS IN CANADA.

BY FRANK C. PERKINS.

The accompanying illustrations show the construction and operation of a novel cylinder snow plow designed and constructed in the Province of Ontario. When the plow of this remarkable machine is forced into a drift or cut, the snow is lifted by the shovel, which is inclined upward and meets the expeller chambers, the snow gliding along until it comes in contact with the expellers, the blades of which revolve at a high speed, in an upward direction. Engaging the snow, the blades throw it upward and outward at a great velocity, delivering it to a distance of 50 or 60 feet on each side of the plow and making a clear cut, 11 feet in width, and at a speed of 6 to 8 miles per hour in a cut 10 feet deep. The snow is elevated and thrown at so great a distance from the track, the possibility of the smallest quantity ever getting into the cut again is precluded. The snow does not enter the expeller chambers, and it is stated that the maximum velocity of the expeller blade at the periphery is 5,654 feet.

The accompanying illustrations are front and side views of this remarkable cylinder snow plow. In one view the snow expellers are shown in operation; in another a cut 12 feet deep is illustrated. The reader will doubtless note the impression which wedge and apron leave on the snow. The thin end projects only 20 inches ahead of the expeller.

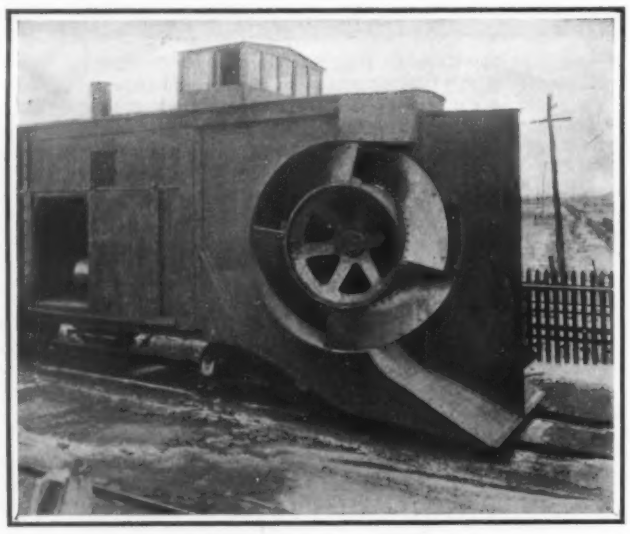
Other illustrations show the cleaned track in a ten-foot cut, and the machinery within the plow car, including the boiler steam pipes and engine. The expellers are directly connected with the engine shaft by means of two steel chain belts.

It is stated that each of the steel chain belts driven by the steam engine of this plow is capable of driving the expellers at a moderate speed alone, so that should one belt be disabled the plow would still be able to work at a somewhat lower rate of speed.

The plow body is of steel construction throughout, the box portion having the sides covered with wood like a box car. The roof is of similar construction, which is fire and water-proof. A door is provided on each side in the middle of the car, the back end being left open for convenience in stoking the boiler. A lookout is built at the front end of the car from which point the engineers can be signalled to.

The front end of the car, entirely of steel, has three chambers, the two side ones being circular, open at the front and one side, in which the expellers revolve. These are nine feet in diameter and three feet six inches wide. Each expeller consists of a cast iron hub, upon which are formed four spiral flanges, having a pitch of about fourteen feet. Riveted to these flanges are four half-inch steel plates or blades twenty-two inches wide, comprising a true helix upon the hub. The expellers are mounted upon each end of the shaft and overhang the pedestals, the shaft extending into the circular chambers. On the middle of the shaft, which is eight inches in diameter, is keyed the sprocket wheel, which is connected with a similar wheel on the shaft of the engine by the steel chains. These four parts constitute the drive gear. The middle chamber opens to the interior of the car. On the front is constructed the nose of the plow, consisting of steel plates projecting forward to the end of the apron or shovel. It may be stated that the apron or shovel is attached to the bottom framing, the side plates, the interior web plates, and the expeller chambers, by steel angles and plates. This apron extends forward five feet beyond the center of the expellers. The nose and shovel, being firmly riveted together, present a rigid construction to engage the snow.

This powerful cylindrical snow plow has engines specially constructed. The cylinders are sixteen inches diameter with eighteen-inch stroke and work under a steam pressure of 150 pounds per square inch, the maximum speed being two hundred revolutions per minute. They are capable of developing 750 I. H. P. and are placed as near as possible to the expellers to shorten the drive chain. The engines exhaust into the bottom of the smoke box of the boiler through a suitable nozzle, similar to locomotive practice, creating a strong blast.



A view showing an expeller.

Hardening of Soft Stone.

Mr. A. Kubelka of Bushowitz in Morairu has discovered a process by means of which the softest sandstone or limestone can be made hard. The process is the following: First, the surface of the stone must be thoroughly cleaned, so as to expose the pores. Any oil or grease spots must be removed with benzine or with the alcohol flame. Missing pieces must be filled up with cement mortar, using a 1:7 solution of waterglass for tempering. After the stone is thoroughly dry, it is saturated with a solution of potash or soda waterglass. In case of rain during or immediately after this operation, the stone must be again cleaned, dried, and saturated with the solution. Then follows an impregnation with molten chloride of calcium. After this impregnation rain will do no more harm, as on account of the reaction of the chloride of calcium upon the solution of waterglass, the pores of the stone will be filled with insoluble, hard silicate of lime, while the soluble silicate of lime will be decomposed and washed out by rain. Another method of Kubelka's is to saturate the stone first with a solution of sulphate of alumina, in water, and when dry with a solution of potash waterglass. Sometimes a repetition of this process will be necessary to thoroughly fill all the pores of the stone. It is enough if the stone is saturated to a depth of about ½ inch. Whitish brush marks may be cleaned either by rubbing with a piece of the same stone, or by refacing the stone, or by brushing with steel brushes. Should the solution not impregnate the stone quick enough, it must be diluted with more water. The solution should be entirely absorbed by the stone in about one minute. Whatever is left over on the surface after this time should be wiped away with a rag, as the crystals formed by the evaporation of the water would make a rubbing and cleaning of the stone necessary. A separate brush should be used for each solution, so that the reaction should begin in the pores of the stone. For larger surfaces atomizers or sprinklers may be used successfully.

Through these processes any soft limestone or sandstone may be made more compact and hard. Their porousness and imperviousness will equal that of the hardest stone. After treatment they may be polished and cut. The great advantages of the soft stones—cheapness of quarrying and cutting—remain, and they can receive afterward all the prominent qualities of the harder stones.

Mortar and concrete may also be hardened and compacted by these processes, so that they may be used with greater success in works calling for water-tightness, as water works, tanks, street pavements, sidewalks, artificial stone, cement blocks, etc.

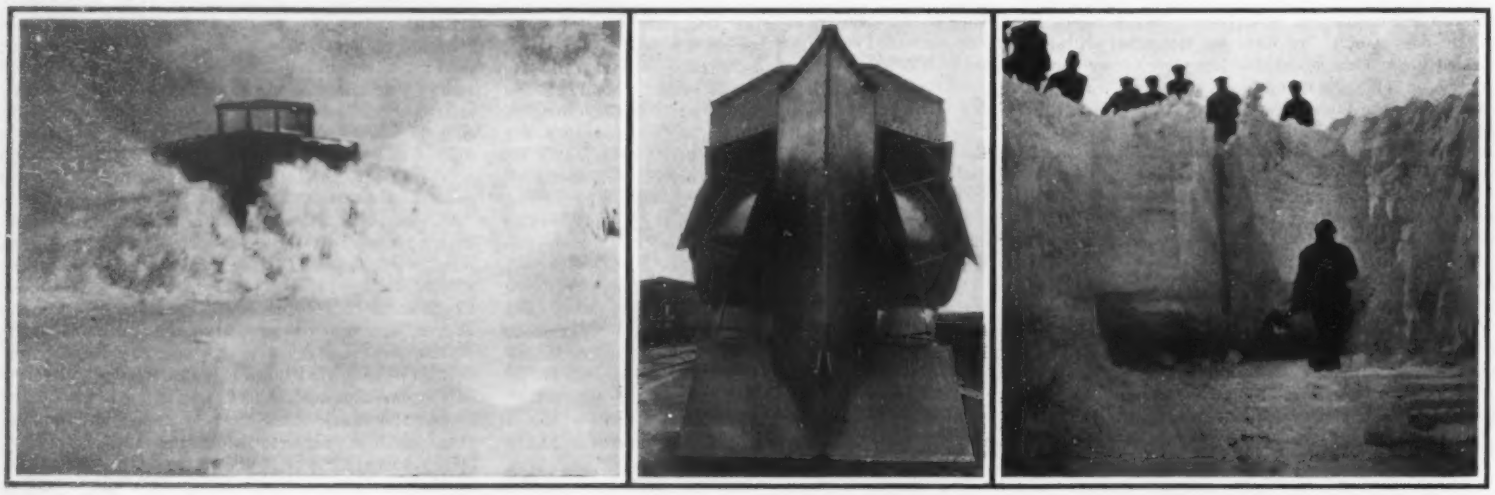
Monuments can also be protected by these processes from the influence of the weather.

Process of Removing Hair from Hides.

An article in the Ledertechnische Rundschau mentions, without describing in detail, a new process for the removal of hair from hides, in which the agents commonly employed for this purpose (lime, sodium sulphide, etc.) are replaced by "a suitable gas," which effects the removal of the hair in from two to eight hours. The process is said to be especially valuable for the preparation of colored leather, and fine leather in general, as the product is of very uniform grain and free from the spots which are often produced by lime and sodium sulphide. The leather is also much closer, tougher, stronger, and more flexible than leather made by the usual methods. Hides treated by the new process may be tanned with bark, extract, or chrome alum. The inventor, whose address may be obtained from the journal quoted, will furnish detailed information to persons interested.

The Coming Aeronautic Show at Boston.

The first Aeronautic Show to be held in the United States without connection with any other exhibition, will open in Mechanics Building, Boston, Mass., on February 16th, and not on the 23rd, as announced in our last issue. This show will remain open one week. Seventeen full-sized aeroplanes have already been secured, and the exhibition promises to be a representative one as far as the heavier-than-air machines are concerned. The manager can be addressed at 5 Park Square, Boston, by any experimenters having machines to exhibit.



The plow in operation. Front view of plow. Plow withdrawn to show nature of cut.

CLEARING SNOW FROM RAILWAY TRACKS IN CANADA.

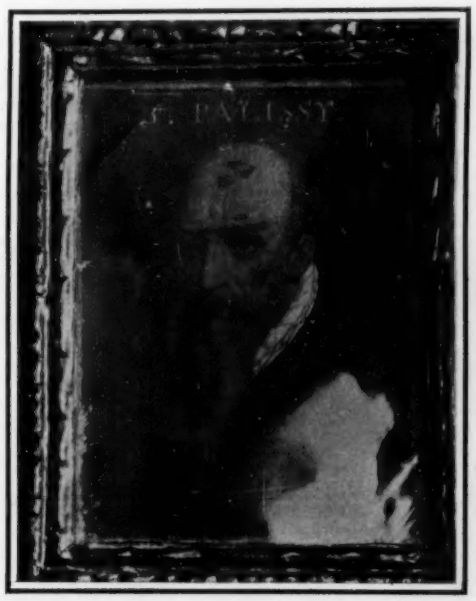
BERNARD PALISSY, THE FAMOUS FRENCH POTTER, AND HIS WORKS

BY CHARLES A. BRASSLER

Bernard Palissy, whose statue by Barrias appropriately graces the court yard of the Ceramic Museum at Sèvres, is one of the most interesting figures in history.

Born about 1510, near Agen, now in the department of Lot and Garonne, France, he was apprenticed early in life to a potter, and interested himself greatly in the technique of his calling, particularly in the possibilities of the various materials. He traveled in France and Germany, keeping this object in view and studying, for this purpose, geology and natural history, supporting himself in the meantime by working as a land surveyor. About 1539, however, he settled at Saintes and here, while engaged in his calling, he began his systematic researches into the manufacture of pottery and the composition of enamels. It was here, he says in his book, "L'Art de la terre," "that without considering that I had no knowledge of argilaceous earths, I began my researches into enamels, like one who gropes in the dark."

An enameled cup of faience which came into his hands inspired him with the determination to discover a method of producing white enamel, and for nearly sixteen years, neglecting almost everything else, he devoted his time and attention to investigations and experiments in this direction. During this period, doubtless, he made the discoveries as to colorings, glazes, etc., that laid the foundation for his future success. His first attempts were unsuccessful, but he pursued his researches with unparalleled persistence and energy, sacrificing everything to what was then considered more or less of a chimera, and to what brought him no profit. He exhausted all his resources, and lacking fuel for the firing of his kilns, was reduced to the necessity of burning piece by piece his household furniture. Ridiculed by his neighbors, bitterly reproached by his wife and tormented by the cries of his hungry children, he nevertheless persevered, until finally, when reduced to the last desperate extremities, success rewarded his efforts.



Portrait of Palissy. From an old French miniature on vellum at Cluny.

Unlike most of the investigators and experimentalists of his time, Palissy had conducted his labors systematically, and when he attained his object, he was able to repeat his work and obtain the same results. A few vessels, ornamented with life-like representations of reptiles, insects and small animals and colored true to nature, were a revelation to the ceramists of those times and brought prices that soon enabled him to forget the hardships through which he had fought his way to success. He continued and perfected his researches and soon became famous, winning favor with the nobility and royalty, in the embellishment of whose palaces his genius was chiefly employed. This friendship stood him in good stead at the time of the massacre of St. Bartholomew, when the powerful protection of Queen Catherine and Anne de Montmorency, wife of the constable, saved him from the fate that befell so many of his fellow Huguenots, for Palissy had embraced the reformed faith.

A man of studious habits and keen intelligence, Palissy was among the earliest of French scientists to substitute for the fables and fanciful theories of so-called philosophers, hard facts, that were capable of practical demonstration. In 1575 he commenced the delivery of a course of lectures on natural history and physics, in which he gave a correct account of the origin of springs, the formation of stones and fossil shells, and advanced theories as to the best methods of purifying water, the use of marl as fer-

(Continued on page 133.)

A cup and pitcher made by Bernard Palissy and now preserved in the Louvre.

Palissy's reproduction in pottery of one of Briot's masterpieces. The Temperentia plate.

Pitcher belonging to the famous Temperentia basin and two candlesticks, all in the Louvre.

Large platter embellished with reptiles, fishes and shells made by Bernard Palissy.

"La Belle Jardinière," a famous plate by Palissy preserved in the Cluny Museum.

THE HEAVENS IN FEBRUARY, 1910.

BY HENRY NORRIS RUSSELL, PH.D.

FIRST among the astronomical discoveries of 1910 is that of a brilliant comet reported from South Africa on the 17th of January.

At that time it was but five degrees south of the sun; but it was so bright that it was visible in full daylight to the unaided eye; and observations of its spectrum, made next day at the Lick Observatory, showed the sodium lines bright on a continuous background—thus proving that the comet was very hot and self-luminous.

This doubtless means that it was then very near the sun, and strongly heated by its radiation.

From the scanty information which is yet available, it appears that the comet is moving rapidly northeastward and diminishing in brightness. Its orbit has been computed and ephemeris will be found on page 123 of this issue. It is probable that it will be visible for a few weeks in the evening sky, just after sunset, and almost directly above the point where the sun disappears. It is, however, quite possible that it may lose so much in brightness, as it retreats from the sun, that it will not be very conspicuous. On the other hand, it may be a fine object; and the evening skies will be well worth watching, especially about the beginning of February, when moonlight no longer drowns out faint objects.

Halley's comet is still visible in the evening sky, and is very slowly increasing in brightness; but it will probably be too faint for the naked eye, though perhaps visible in a field glass.

It will fortunately be easy to locate. Just north of the planet Saturn are three stars of the fourth magnitude, in an east and west line. On February 5th the comet will be about 50 min. of arc (or, roughly, one and a half times the moon's diameter) north of the middle one of these stars, and on the 17th it will be about the same distance north of the westernmost of the three. By following this line of motion it can easily be found at any time.

By the end of the month it will be pretty low in the west at sunset, and soon after it will vanish in the twilight, to reappear, much brighter, in the morning sky in April.

While the appearance of these comets is exciting so much interest, a notable advance has been made in the explanation of these phenomena. Observations of the spectra of the last two bright comets (Daniel's and Morehouse's) showed that the light of the tail consisted almost entirely of bright bands, given out by some luminous gas. But at that time no gas was known which gave just these bands. Very recently Mr. Fowler, of South Kensington, England, has found that a vacuum tube, containing small quantities of nitrogen, and of carbon compounds (excited electrically so as to glow), shows a spectrum exactly like that of the comet's tails, provided the pressure of the gas is made exceedingly small.

As the pressure and density of the gas in a comet's tail must be almost incalculably less than in any vacuum which we can produce by mechanical means, this gives us a satisfactory explanation of the observations. The luminous particles, though so thinly distributed through space, are molecules of familiar gases; and one of the mysteries which surround comets has been cleared away.

THE HEAVENS.

The splendid and familiar winter constellations are now seen in all their glory.

Due south, and about half way up the sky, is Orion. The very bright star below him, to the left, is Sirius. West of this, directly below Orion, are the small groups of the Hare and the Dove. Far below the latter, on the southern horizon, those who live south of Virginia or Missouri can see a star of exceptional brightness. This is Canopus, the principal star of the great constellation Argo, and, next to Sirius, the brightest in the heavens. This star's brightness might make us anticipate that, like Sirius, it might be a near neighbor of ours in space; but repeated and careful observations show that this is not so. Its distance is too great to measure accurately, but it is at least ten times as far off as Sirius, and probably much farther from us. Canopus must therefore be really a most magnificent luminary, exceeding our sun at least a thousand-fold in brightness.

To the left of Orion and Taurus are Canis Minor and Gemini, and right overhead is Auriga, with the bright star Capella. In the southwest there is nothing of much interest, but in the west we see two bright objects, one above the other, not marked on the map. These are the planets, Mars and Saturn, whose motion among the stars makes it impossible to put them in our permanent maps of the heavens. Mars is higher up than Saturn, and is redder in color.

In the northwest we see Andromeda and Cassiopeia, and above them Perseus. This is another of the constellations which bears no real resemblance to anything in particular; but with the aid of the drawing in our initial it is possible to see how the ancients found here the figure of the hero carrying the head of the Gorgon Medusa, which is marked by the bright star Algol.

The bright spot in the Milky Way, between Perseus and Cassiopeia, is a splendid star cluster, showing well in the smallest telescopes.

To see how the northern constellations appear in the sky, we must turn our map upside down, so that the words "Northern Horizon" are at the bottom. It will then appear that Cepheus is below the Pole, on the left. The Little Bear hangs by its tail from the Polestar. The Dragon is below, with his head out of sight and only his tail showing. The Great Bear is climbing up the heavens to the eastward, and is already high. In the east is Leo, pretty well up, and above is Cancer, with the star cluster Praesepe. Farther to the right is Hydra—an immense constellation, whose head is already high, while its tail will continue to drag itself into sight for three hours longer.

THE PLANETS.

Mercury is morning star throughout the month, but is unfavorably placed south of the sun. He may be best seen about the 20th, when he rises about 5:40 A. M. Venus is evening star until the 12th, when she passes between us and the sun and becomes a morning star. At the beginning of the month she is easily visible in the evening, setting more than an hour and a half later than the sun, and at its end she is similarly conspicuous in the morning skies.

During the middle of February she will be invisible to the naked eye; but as she passes almost 8 degrees north of the sun, she should be observable telescopically, in full daylight, as a thin crescent, all through this time.

Mars is evening star in Aries, remaining in sight till nearly midnight.

Jupiter is in Virgo, rising about 10:30 P. M. at the beginning of the month, and 8:30 at its close.

Saturn is evening star in Pisces, setting about 10 P. M. in the middle of the month.

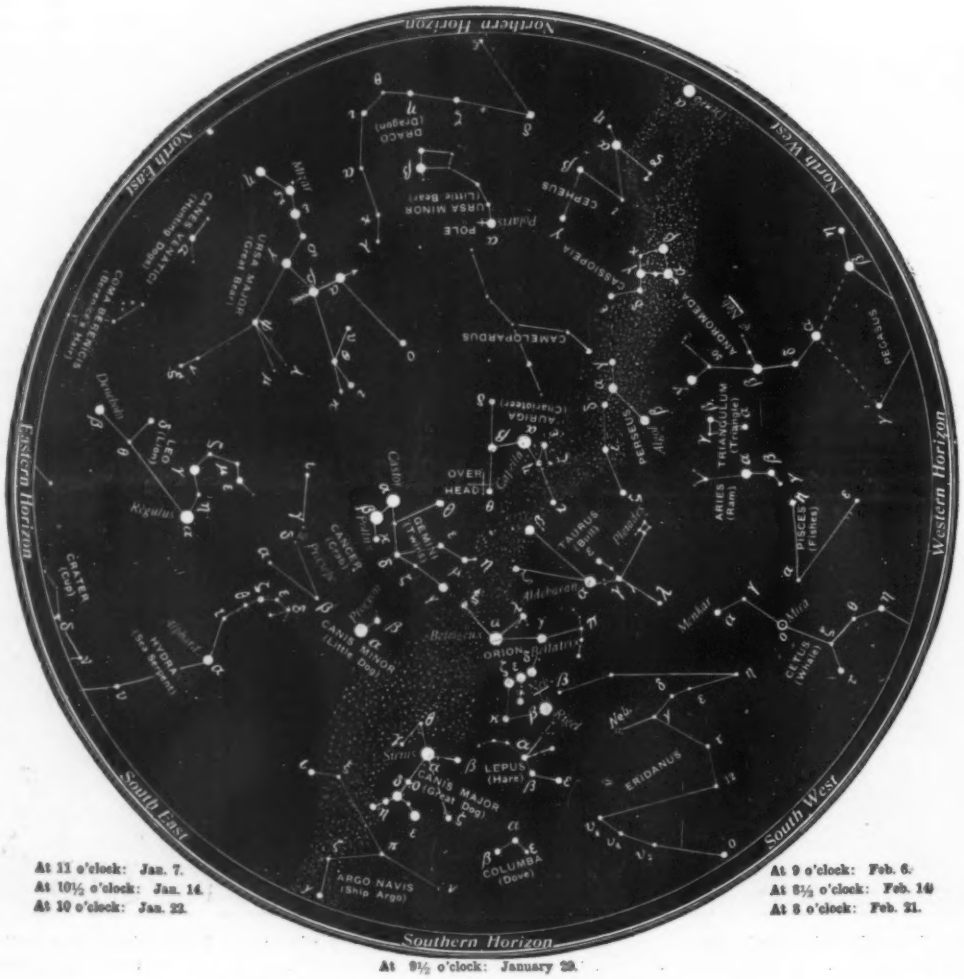
Uranus rises only about 1½ hours before the sun, and is unobservable.

Neptune is in Gemini, observable all the evening, but only with a good-sized telescope.

THE MOON.

Last quarter occurs at 6 A. M. on the 2nd, new moon at 8. P. M. on the 9th, first quarter at 10 P. M. on the 17th, and full moon at 3 P. M. on the 23rd. The moon is nearest us on the 12th, and farthest away on the 28th. She is in conjunction with Uranus and Mercury on the 7th, Venus on the 9th, Saturn on the 13th, Mars on the 15th, Neptune on the 20th, and Jupiter on the 27th.

Princeton University Observatory.



NIGHT SKY: JANUARY AND FEBRUARY

The Library of the Assyrian King, Sardanapalus.

During the interval of the past fifty years twenty thousand stone tablets, approximately, of the library of the Assyrian king, Sardanapalus, were found in the course of excavations among the ruins of Nineveh and taken to London. The texts written on them, which are related to one another apparently, are now published in their original cuneiform script by the British Museum in serial collections. Various savants of the whole world have therefore an opportunity for further investigation of the texts of their special province, for every kind of text in cuneiform script presents its own particular difficulties to the translator and commentator. In the fourteenth collection, or volume of the work are assembled those tablets of the king's library which regard chiefly the objects of the three natural kingdoms. Obviously many of these lists were prepared for purposes of medication.

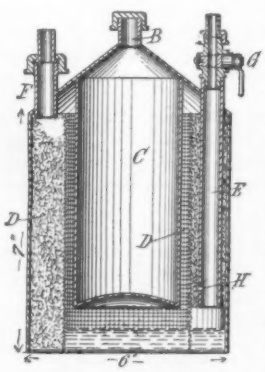
For this reason a prominent physician, Baron Oefele, assisted by noted scholars in cuneiform script, among them Prof. Zimmern of Leipzig, began to examine this collection with a degree of zeal that has become quite prolific. Apart from the many lists which mention minerals, the numerous lists of animals are mostly of a uniform kind. The names of animals are arranged in two columns, the same names being given in the first column in Sumerian and in the second column in Accadian; that is, in Babylonian. Still far more interesting than the zoological lists are the botanical lists, of which there is a great number, and which give the most various directions to acquaint the aspiring physician with the effect and use of hundreds of medicinal plants. This fact may suffice to show that among the old Babylonians the knowledge of the natural sciences was already far greater than among their successors, the Greeks and Romans, whose names of animals and plants, it is manifest, have been derived partly from the Babylonian language.

The shortest track for steamers from Panama to Yokohama, Shanghai, and Hongkong passes in close proximity to San Lucas Bay, near Cape San Lucas, at the southern end of Lower California, and to the ports of Manzanillo and Acapulco on the mainland of Mexico. Perhaps Manzanillo should be regarded as the closest port.

METHOD OF ECONOMIZING GAS.

BY A. J. JARMAN.

How to economize the consumption of gas for illuminating and heating purposes is a question of considerable importance to-day. The price charged for coal gas at the present time in many towns and cities is so high as to prevent its use for cooking purposes. Only by exercising the utmost economy in using only just enough to cook the small quantity of food required does the use of gas for cooking become advantageous under such conditions.



SECTION OF THE GAS ECONOMIZING APPARATUS.

By means of a simple apparatus the heating qualities of the gas can be improved so as to reduce cooking expenses and the cost of lighting as well; for in Welsbach and kindred lamps it is the heat of the burning gas that renders the mantle brilliantly incandescent. Moreover, the lighting qualities of the gas are greatly improved as well. The following apparatus, which was first made by the writer in 1872, has been put to the test in hundreds of cases and has proved its efficiency in every instance. Any man who is handy in the use of metal-working tools can make one and fit it to suit his gas supply by attaching it to the supply pipe after the gas has passed the meter; the gas then belongs to the consumer, it being the property of the gas company before it passes the meter.

The apparatus here described is suitable for a ten-light meter, with all the fittings for lighting, heating, and cooking. It consists of a closed tin cylinder *A*, six inches in diameter and seven inches high without the conical top. Within this vessel is placed another cylinder made of galvanized wire netting, with a half-inch mesh, the diameter being four inches and height seven inches. This wire cylinder is placed within the tin case, having a one-inch space all round. Within this space clean, white cotton waste is packed. A tin cylinder *C* six and a half inches long and three and one-half inches diameter is soldered all round to the cone top of the cylinder *A* and is provided with a perforated bottom to allow the hydrocarbon with which the economizer is to be charged to run through and saturate the cotton waste *D*. The cylinder *C* acts as a spreader, causing the gas which enters by way of pipe *E* to contact in a thin layer with the cotton waste held by the galvanized wire cylinder and then pass out through pipe *F*. The apparatus is charged with benzine, gasoline, or a similar volatile hydrocarbon capable of being taken up by the nonilluminating constituents of coal gas, such as hydrogen, marsh gas or carbonic oxide. At *G* is a suitable brass stop-cock, which enables one to turn off the gas when charging

A 100-LIGHT AND A 10-LIGHT GAS ECONOMIZER.

the apparatus with gasoline. The brass cap at *B* must have a disk of pliable leather fitted in the interior so that it becomes perfectly gas-tight when screwed down. It is necessary to make a hole in the supply pipe *E* at *H* so that in case the gasoline should cover the bottom of the inlet pipe this would prevent any flickering of the light due to bubbling of the gas through the liquid. The charging of the apparatus must be carried out in daylight, and it should be fitted near a window where daylight is admitted, for a lighted match, candle, or lamp must not be used. With these simple precautions the apparatus is perfectly safe. The cone top must be perfectly soldered where the tin cylinder meets, and all the brass connections attached to the inlet and outlet pipes must also be perfectly soldered. India rubber piping or connectors must not be used, soldered connections, metal piping and screened brass connectors alone must be used. When the economizer is fitted and charged with about three pints of gasoline it will be found that the intensity of light from an ordinary naked burner will be vastly improved.

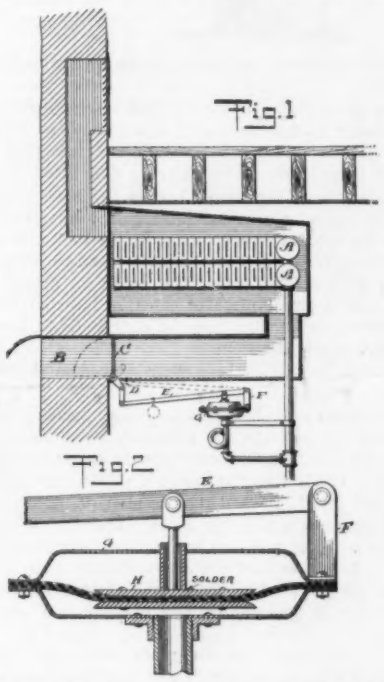
It has been found that half a gallon of benzine will take the place of 500 cubic feet for direct illumination in this apparatus.

The cotton waste in the economizer must be packed moderately tight. If packed too loose it will sink and give less surface for the gas to reach the gasoline. Be sure and mark the outer end of the inlet pipe *IN*. This will prevent any mistake when installing the device.

REGULATOR FOR INDIRECT AND DIRECT-INDIRECT STEAM HEATING.

BY B. A. JOHNS.

Every indirect and direct-indirect steam heater should have some kind of a regulator so as to shut off the air supply when there is no heat in the radiator; otherwise, especially at night when the steam pressure goes down and the air box remains open with the



REGULATOR FOR INDIRECT STEAM HEATING.

cold wind blowing directly into it, it will soon cool off the house.

The accompanying illustrations show a very simple way to make such a regulator. Fig. 1 shows the general arrangement of an indirect heating radiator, and Fig. 2 shows in detail the regulator.

The radiator *A* is inclosed in a box in the usual way, taking its air from the outside through the passage *B*, and having a shutter or damper *C* mounted to turn in suitable bearings on a shaft. The latter has a small bell crank *D* secured to its outer end which through a link is connected to a lever *E*. The lever *E* is pivoted in suitable brackets *F* fastened to the regulator *G*. The regulator can be made of two small frying pans or skillets, say about 6 inches in diameter. A part of the conical rim is bent outward, forming flanges for bolting the same together. The bending is done very easily. Place the skillet over the edge of an iron block, and with a flat peen hammer stretch the edge, say about ¾ inch all around. To the lower head, rivet a small floor flange, which will serve for connection with the steampipe from the boiler. In the center of the upper head a hole is made large enough to receive a half-inch nipple. To the lever is fastened a short rod, which passes down through this nipple to the diaphragm *H*.

The diaphragm is made of sheet rubber, say 3/16 inch thick with one or more layers of duck in it. To the top and bottom disks of iron with beveled edges about ¼ inch thick are riveted. To the upper disk is soldered a half-inch nipple or piece of pipe, serving as a guide. The whole is now placed between the two heads of the regulator and bolted together very closely.

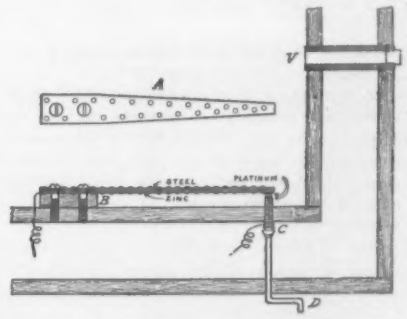
To the lower head is fastened the usual siphon pipe to prevent the steam from entering the regulator. As the steam pressure rises it will force the diaphragm upward, thereby opening the shutter *C* in the air passage *B*, permitting the cold air to pass under and through the bank of radiators, thereby heating them thence up through the register into the room and will keep it open until the steam pressure goes down. The weight of the arm *E* will then close the shutter, permitting no more air to pass until again opened by the steam pressure. A weight may be attached to this lever, so as to close the shutter more effectually.

THERMOSTATIC ALARM FOR HOUSE HEATERS.

BY F. F. ALLEN.

The accompanying diagram shows how a simple alarm for house heaters can be made.

The object of this alarm is to give warning when the furnace is overheated and needs attention, or when the fire is nearly out and needs more coal. A thermostatic bar *A* 1½ inches by 1/16-inch is made of copper



THERMOSTATIC ALARM FOR HOUSE HEATERS.

and iron riveted together very closely and fastened at one end are brackets *B*, which are secured to a suitable base *H*. The free end of the bar *A* moves between two contact points *D*, made of ordinary screw-eyes. These are screwed into posts *C*, made of ½-inch dowel and secured to the base *H*.

The whole is fastened in an inverted position over the furnace or other place where there is danger of overheating. After the contact points are adjusted to close the circuit at the proper temperature they are connected up to an electric bell and battery as indicated in the drawing.

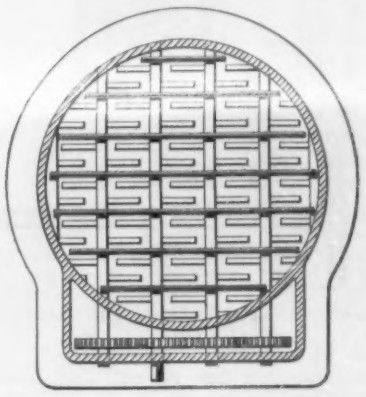
A switch is placed in the circuit at some convenient point. It will now be seen that when the thermostatic bar *B* moves to either side, according to the temperature and makes connections with contact points *D*, the bell *E* will ring. When the apparatus gives the necessary alarm the switch must be turned off until the trouble is remedied.

ADAPTING A GRATE FOR SMALL COAL.

BY J. A. BERGSTROM.

The grates in the ordinary house heating furnaces are regulated and made for the best and most suitable size of coal to be used in each particular case. That is to say, in a large hot-air furnace where egg coal is most suitable, a very coarse and open grate is provided, but in a smaller furnace, where smaller coal is to be used, a much closer grate is furnished.

In some localities where pea coal is much cheaper than egg, stove or nut, it would perhaps be more economical to burn the pea coal, provided the grate would permit. As a rule, if the pea coal is used in these large furnaces, it has not proved very successful on account of the coarse grate, unless a new one is put in more suitable for the smaller coal, as the shaking of



GRATE ADAPTED FOR BURNING SMALL COAL.

the old grate will cause the whole fire to dump into the ash pit.

To overcome this the writer has tried several methods and has come to the conclusion that the best is that shown in the accompanying illustration.

The grate is an ordinary rocking-finger grate. Between every or every other finger (which will depend upon the kind of grate and also of the size of coal to

be used) is placed across the entire grate a piece of say ½-inch pipe or bar. These pipes or bars rest on the grate bars and are not affected by the rocking of the grate. As the ashes accumulate on top of these bars they have a tendency to keep them in place and will prevent them from moving or burning.

There should always be a layer of an inch or two of ashes on any grate. Care should be taken not to shake the grate too much, as a great deal of live coal will fall through and sometimes start to burn in the ash pit, thereby warping and destroying the grate bars.

The writer has used some old pipes and grate bars for a number of years and to-day they are as good as new. Some years ago, during the coal famine, a great deal of bituminous coal was burned with perfect success. It is best when starting a new fire to clean out the ash pit, and if any live coals fall through they may be shoveled up on the fire again until enough ashes are formed to prevent them from falling through.

HOW TO BURN COAL ECONOMICALLY.

BY W. B. ALLEN.

The accompanying illustrations show how in a very simple way the gases in an ordinary furnace may be consumed and burned, thereby giving off a more uniform heat and maintaining an even temperature throughout the house continuously, night and day. It will effect a saving on the coal bin and produce more heat besides.

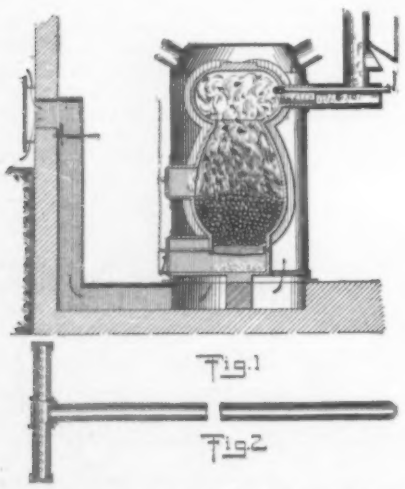
The fire in a stove or furnace is simply the result of a chemical union of the carbon properties of the fuel, both solid and gaseous, with the oxygen of the air.

By the complete combustion of one pound of coal 14,600 heat units are given off, but by the incomplete combustion of one pound of coal, as burned in the great majority of domestic heaters, only about 4,000 to 5,000 heat units are produced and the balance of the heat passes away up the chimney, a rich combustible gas that should have burned.

To obtain the highest efficiency from coal it must be burned with the least possible supply of air consistent with perfect combustion, as an excess of air carries the heat of the fuel into the chimney and a certain mixture of air from below the grate will cause an explosion in the smoke pipe, blowing the fire door open and filling the cellar with spent gases.

Nearly every furnace discharges so-called "coal gas," which is due either to poor draft or a defective furnace, or an improper adjustment of the dampers. As the odor is so noticeable, the difficulty is soon remedied. Every furnace, however, is constantly discharging more or less carbon monoxide gas, which is perfectly odorless and is a very energetic poison, as the result of imperfect combustion.

Ordinarily the domestic user of coal roasts out the gas, opens the dampers and drives it up the chimney and then proceeds to burn the coke, which is only about one-half of the heat value of the coal, besides it is not alone the heat that escapes up the chimney, but the rich combustible gas that passes away unconsumed. This gas when burned produces a uniformly



ARRANGEMENT FOR BURNING THE GASES OF THE COAL.

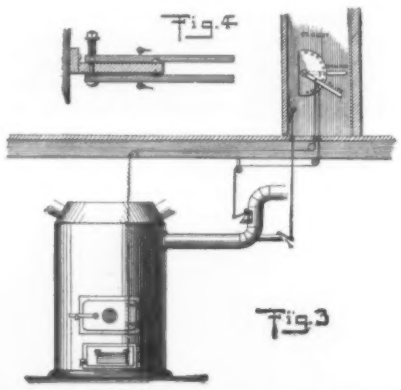
higher temperature than the coal itself, which may burn at varying temperatures, even so low as to produce but little heat.

The clinkers that form in the furnace are the result of an excessive draft below the grate.

To accomplish the mixing of the hot gases and air the air must be heated to the same temperature.

The most common domestic heating furnace is the hot-air furnace. This is simply an improved stove inclosed in a sheet-iron or brick casing. The furnace heats the air within this inclosure to a high temperature and therefore rises to the rooms above through tin pipes. To keep this current of hot air rising, a "cold-air box" connects the lower part of the furnace with the outside air and is regulated with a damper. This cold-air box should always be kept open as much as possible and never entirely closed while there is fire in the furnace, as the furnace will become overheated and may be injured.

Fig. 1 shows how the common hot-air furnace may be adapted to burn the gas of the coal. A small pipe, say 1 inch or 1¼ inch is inserted through the upper part of the smoke pipe (as the gases here are the hottest), terminating in close proximity to the smoke collar just inside of the radiator of the stove. The inner end may be fitted with a suitable spreader, such as shown in detail in Fig. 2. The cross pipes have a number of 3/16-inch holes drilled in the lower side, or



HAND METHOD OF REGULATING THE DAMPERS.

facing downward. The outer end of the pipe is fitted with some kind of a damper to regulate the supply of air. As the cold air passes through this pipe it becomes heated and at its delivery end is of the same temperature as the gases, but as the specific gravity of this heated air is much greater than that of the gases in the furnace, it drops down and mixes with the gases, forming a combustible mixture which now burns with a blue flame, just as in an ordinary gas stove. If a small piece of mica is inserted into the fire door this burning may be observed. It is a very interesting phenomenon.

In order to make the system a success the fire pot must be in perfect condition; that is to say, in a hot-air furnace there should be no communication between the fire pot and the air chamber, no cracks and no loose joints. The fire door should be as air-tight as possible. This may be made tight in the following manner: First, file and remove all rust at the edge of the door until a metallic surface appears; then cut a narrow strip of asbestos and soak in salt water, after which place it around the door and it will adhere. Put a litle oil on the door frame and close the door. The asbestos will then fill up any opening and bake very hard on the door.

If everything below the grate were absolutely air-tight no combustion would take place, but as all furnaces leak more or less this leakage is enough to support combustion in ordinary weather. In extremely cold weather, however, the slide in the ash pit door may be opened a little, so as to furnish a little more air.

A damper is attached to the smoke pipe above the air pipe, so that when open it will not cool off the air pipe.

A fire is built in the furnace the ordinary way; keep the air damper closed until a good fire is obtained, then put on some coal and keep the lower damper open for a few minutes, after which close all drafts and open the air damper, regulate the same according to the heat required; that is to say, more heat, more air. Through the before-mentioned mica window observe the results. All the gases in the furnace will, however, not burn, as some are bound to escape unconsumed.

There is more economy in running a large, slow fire all day long than a hot one at intervals. Therefore it is best to coal the fire twice a day, in the morning and at night, and regulate it so that the fire burns with an even temperature. It will keep the house at a uniform temperature night and day.

When the furnace has been cooled for the day or the night the dampers may be controlled from any room above by simply raising or lowering a lever connected with wires running over pulleys to the various dampers, thereby saving many a step. This is shown in Fig. 3; a sectional plan of the levers is shown in Fig. 4.

In ordinary weather the fire should only be shaken once a day, preferably in the morning, but in very mild weather twice a week will suffice. Only shake until the first red coal comes down. In furnaces with very strong drafts shake but very little, as the layer of ashes on top of the grate will help check the draft. If the fire is very low stick a few pieces of kindling wood into the fire. This will heat up the smoke pipe. The ash-pit door may also be opened until the fire is drawn up, then regulate as before described.

With this arrangement in good working order every particle of coal will burn to an ash. The slate in the coal, of course, will not burn.

This applies to all three heating systems in domestic use, namely, hot air, hot water, and steam, as it only takes care of the fire.

In hot-air heating, in addition to regulating the fire, the cold-air box must be regulated. This box generally terminates outside the building under a porch. It has always been a source of annoyance because of changes in the direction of the wind. Sometimes the wind will blow directly into it and cool off the house, but when the wind is in another direction it will suck the hot air out from the furnace into the atmosphere. To overcome this a shield is placed in front of the box, say 8 inches from the building, overlapping about 12 to 18 inches all around. Then it will be impossible for the wind to interfere with the regulation of the air, which is generally done in the cellar with a damper or shutter.

The pipes in the cellar leading to the registers should be kept clean, also the registers. Avoid putting any wire netting to catch articles dropped thereon, as it will catch more dirt than anything else, sometimes clogging up the meshes completely, forming an excellent breeding place for bacteria.

The water pan should be connected with the water supply, controlled by a float valve. This insures an even water level in the furnace.

In steam heating plants the boiler and radiators should be large enough to keep the house at a temperature of 70 deg. in zero weather with one pound of steam, as this will take a great deal less coal than when the boiler and radiators are too small, and require a steam pressure of 10 to 20 pounds.

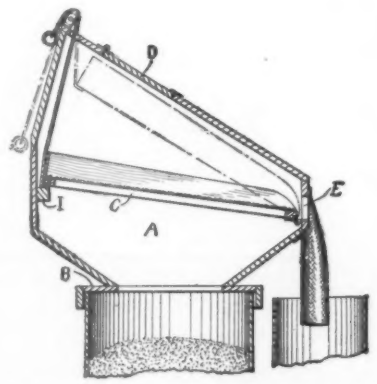
In houses where the draft is good one day and poor the next, despite favorable winds, the fault is with the chimney. It should be built higher. This is a great deal cheaper and better than to put an unsightly cap on it.

HOME-MADE ASH SIFTER.

BY J. A. BROPHY.

A dustless ash sifter can be made at a very small expenditure of money by following the lines of the accompanying drawing. Make a box *A* shaped as shown about 2 feet high, 2 feet long, and 10 inches high at its lowest part. The box should be of such a width as to fit a square hole in a base board *B*. Make the base board square to fit over top of an ash can and cut a square hole in the base board of such a size as to be entirely within the diameter of ash can. Nail the base board to the bottom of the box.

Then make a frame *C* of 1-inch wide stock, 1 inch narrower than the inside width of box and 1 inch shorter than the inside length of the box. Bore a ¼-inch hole in the center of one end of this frame and cover the frame with ½-inch mesh galvanized netting. Inclose three sides of this frame with thin board about 5 inches high, tapering the two sides, as shown,



SECTIONAL VIEW OF THE HOME-MADE ASH SIFTER.

and leaving the discharge end open, which should be hinged to front end of box with two 2 by 2-inch hinges. Put a piece of rope through a hole in the upper end of frame and fasten it on top so that it will not pull out.

The box is now ready for the top which has a hinged door *D*, as shown. On top of box place a pulley and run the rope through the hole in the top of the box and over the pulley wheel. The end of the rope may have a large ring attached to it as shown.

This arrangement will allow the sifting frame to be swung up and down, jarring the frame every time it strikes the block *I* fastened to rear of the box.

Over the opening in front of box fasten a bag-shaped cloth to guide the clinkers to a suitable receptacle and prevent dust from rising.

This sifter has proved very clean and does not require a second shoveling of sifted ashes.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BUTTON.—N. TWEET, Hillsboro, N. D. This invention refers particularly to means of attaching buttons to garments and the like. The object is to produce a button having a resilient or extensible shank of improved construction, which will yield or give under strain so as to relieve the strain to which the attaching stitches or cord is subjected.

Electrical Devices.

SPARKING DEVICE.—I. W. GILES, New Bedford, and C. W. TOBEY, Fairhaven, Mass. An object of this improvement is to provide a circuit breaker on an induction coil which will give one large spark instead of a succession of sparks, such as those produced by the ordinary form of vibrator. Means are provided by which the core of the coil may be thoroughly magnetized before the break occurs.

Of Interest to Farmers.

COVERED BARN-DOOR TRACK AND HANGER.—E. F. MONNIER, Coggon, Iowa. The principal objects which the present invention has in view are: to provide a device for hanging sliding doors, which is fully protected from rain and snow; and to provide a device which is simplified in construction and arranged to permit the installation thereof by an unskilled person.

HAY-LOADER.—J. A. JOHNSON, Wasco, Ill. The mechanism carries the hay from the ground to an elevated point, and deposits it into a suitable vehicle. The elevation of the material handled is conducted so that the tailings are not carried over and deposited between the vehicle being loaded and the loader.

BEATER FOR THRESHING-MACHINES.—J. F. HINES, Strawberry Point, and G. FELLER, Osborne, Iowa. In the present patent the object in view is the provision of a beater frame, simple in construction while efficient for the purpose, and which may be easily removed and replaced, and whose stroke may be adjusted in length independently of the other frames in the series.

Of General Interest.

PICKPOCKET-DETECTOR.—M. WALD, New York, N. Y. This invention relates to an improvement in garments, and particularly to a new and improved pocket, which is formed with a deep true pocket, and a shallow false pocket and detecting the intrusion of a pickpocket's hand therein. The pocket may be attached to any part of any garment.

DREDGING-SLEEVE.—W. P. SUGG, Oakland, Cal. The object of the invention is to produce a sleeve having a protecting wall or coat of mail extending continuously around the axis of the sleeve and protecting it against injury from sand, gravel and small rocks, but at the same time permitting perfect freedom in flexing or doubling the tube.

BASKET-HOLDER.—G. S. PAINE and A. D. PRIEST, Winslow, Maine. The purpose of the invention is to provide novel features of construction for a basket holder, particularly adapted for the reliable holding of a plurality of berry baskets or other small fruit baskets at the front of the gatherer, so that berries may be conveniently removed from the plants or bushes and deposited in the baskets, both hands of a person being free for the gathering operation. When the baskets are filled with berries, they may be removed by sliding them from engagement, and empty baskets may be placed in position.

HYDRAULIC AIR-COMPRESSOR.—J. W. NEAL, Kelia, Hawaii. The invention provides a new hydraulic air compressor, arranged to utilize the force of the pumped water to compress the air isothermally in a very simple and efficient manner. It relates to compressors, more especially designed for use with wave motors, such, for instance, as shown and described in Letters Patent of the U. S., twice formerly granted to Mr. Neal.

COFFER-DAM FOR PLACER-MINING AND PIER-BUILDING.—L. F. GILMAN, Spokane, Wash. The object here is to provide details of construction for a coffer dam, which is adapted for erection at a selected point in a stream of water, and incloses an area of the bottom thereof, any suitable means for the removal of water from the dam being employed, to permit an excavation to be made in the soil thus exposed.

BARBER'S CHAIR.—A. FIORE, Trenton, N. J. The seat in this chair is both revoluble and movable forwardly and rearwardly, and means are provided for positively locking the seat in successive positions against turning and means for locking the seat against forward and rearward movement, with a unitary device, such as a crank, for operating both of the locking means.

MEAT-HANGER.—J. FOWLER, New York, N. Y. The improvement has in view a hanger in the nature of a clasp, which is adapted to be easily applied to and detached from a side of bacon or other similarly shaped piece of meat, and operates to firmly press on the meat at each side and give it the desired shape.

SIPHON.—W. P. CHRISTOPHER and C. DE LUKACSEVICS, New York, N. Y. This siphon is for use in dispensing beverages and some medicines. The bottle being filled with a liquid for instance carbonated water, the operator may discharge the contents of the bottle by merely pressing upon a knob. When the pressure is relaxed the bottle is closed automatically.

POST-FORMING MOLD.—W. W. BAILEY, Chadwick, Ill. This invention consists of a post forming device or mold which will permit of a post being formed in a somewhat wet condition, and one in which the act of removal of the side walls of the mold will cause a troweling action and produce a smooth finish to the sides of the finished post.

Hardware and Tools.

DOOR-LOCK.—C. R. WALLIN, New York, N. Y. In this patent the object of the invention is the provision of a new and improved door lock arranged to lock the main bolt against movement unless first unlocked by the key, to prevent withdrawal of the latter and duplication thereof by unauthorized persons.

BACK-BAND HOOK AND CLAMP.—J. P. FREEMAN, Social Circle, Ga. Among the principal objects which the present invention has in view are: to provide a clamping device to take up or to splice a flexible member of harness for attachment of the same to a chain; and to provide an implement of this character which is simple, economical and durable.

COMBINATION-TOOL FOR MINERS' USE.—A. V. DES MOINEAUX, Denver, Colo. The purpose in this instance is to combine and arrange in a novel manner a plurality of implements that are necessary for preparing explosive blasts, wherein dynamite in stick form is the explosive agent that is to be fired by electricity or other means.

RAZOR-STROP.—R. E. BROWN, Tidioute, Pa. A means is employed to connect the strop with the swiveled suspending eye or device avoiding the usual bolt and nut arrangement generally objectionable for the reason that it wastes substantial length of the strop, is bad in appearance, scrapes and scratches wherever it contacts and is unsatisfactory in packing several strops together in a box.

Heating and Lighting.

GAS-BURNER.—H. C. FABER, Monongah, W. Va. Among the principal objects which the present invention has in view are: the provision of an apparatus wherein air, steam and gas are mixed and burned; and the provision of an apparatus wherein the quantity of gas being mixed with the other ingredients may be regulated.

Household Utilities.

WINDOW-CLEANER.—M. AX, Red Bank, N. J. One object of this inventor is to provide an improved means for detachably securing a wiper-strip upon a window cleaner. A further object is to provide an improved form of tank and fabric-supporting means, whereby a fabric may be removably attached to the tank.

REMOVABLE BROOM-PROTECTOR.—BERTHA CLARK, New York, N. Y. In this case the object of the invention is to provide a device which can be attached to the head of a broom and which will operate as a protector for the broom straws so as to reinforce them. In this way the device has a tendency to increase the utility and durability of the broom to which it is attached.

RECEPTACLE LIFTER.—J. E. WENMAN, New Philadelphia, Ohio. This lifter can be removably associated with cooking utensils or other receptacles of different kinds and sizes, to permit their manipulation, which can be locked or clamped in position at the rim of a receptacle, by a simple manipulation, which requires the use of but one hand, and which does not interfere with the use of a lid or cover upon the receptacle, and can, in fact, be used to hold the cover in place.

CLOSET-FITTING.—W. M. WEATHERLY, Greensboro, N. C. In the present patent the invention has for its object amongst others to provide a construction which will permit the closet to be used, when necessary, when roughed for standard fixtures and will also take standard closets with gasket arrangements.

PERCOLATOR.—B. N. YOUNG, Ottumwa, Iowa. The object is to provide in this invention a device which may be cheaply constructed, and which may be applied to existing coffee pots without any change therein. The percolator is adapted for making postum and similar beverages. There is no possibility of burning the beverages, since they are elevated above the bottom of the vessel.

Machines and Mechanical Devices.

TENSION DEVICE FOR WIRE SAWS.—J. M. OWENS, Oolitic, Ind. This device for wire saws of stone-sawing machines is arranged to permit convenient vertical and horizontal adjustment of the sheave, over which passes the endless wire saw, to give the latter the necessary tension and to bring the saw into proper position according to the thickness of the slab to be cut from the stone block. The invention, relates to stone-sawing machines such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Owens.

ROTARY PRESS.—J. A. DOWD, Fall River, Mass. There is provision in this invention for a device which will compress material efficiently and rapidly, and draw off the liquid exuded from the material, in a convenient and thorough manner. It relates to a rotary press that forces the material to pass through a constricted neck, squeezing out the last particles of moisture.

SPRING-POST FOR WOODWORKING-MACHINERY.—C. T. CUNNIUS, Long Branch, N. J. The object of this inventor is attained by providing a manually-controlled gearing for turning the post and locking it in the desired turned position; by making the post vertically adjustable and providing means for locking it to the gearing, and by providing a locking device for adjustably locking the spring finger to the post.

Prime Movers and Their Accessories.

VAPORIZER-HEATING DEVICE.—A. E. OSBORN, New York, N. Y. This invention provides a means by which the headlight or other lantern of the automobile may be utilized to heat the vaporizer, so that when starting the machine it is only necessary to light the lamp which will furnish the heat necessary for starting the operation of the vaporizer, and if desired this heat may be continued throughout the entire operation of the machine.

STARTING EXPLOSION-ENGINES.—J. E. MALIVERT, 32 Rue Pergolèse, Paris, France. The method in this invention effects the starting of the engine by admission to the cylinder of a charge of compressed air upon the stroke in which the explosion would be normally taking place, and is characterized by the arrangement of a diaphragm valve for each cylinder for admitting compressed air from a receiver, the operation of these valves at the correct moment for each cylinder being determined by a distributer in constant relation with the engine shaft, normally maintaining upon the diaphragms a pressure of compressed air which balances the diaphragm and keeps the valve closed, and releasing this balance pressure when the compressed air is to be admitted to the cylinder.

GAS AND STEAM POWER-GENERATOR.—E. E. LAMSON, Salt Lake City, Utah. The purpose here is to transpose the heat units of gas fuel into a mixture of steam and combustion gases suited in pressure and mass and temperature to supersede steam in operating those types of engine; and, by thus linking them to gas producing apparatus, to embody a gas and steam power-system which will retain the advantages of the steam engines and combine with them the thermal efficiency of the explosive gas engine.

Railways and Their Accessories.

SAFETY ATTACHMENT FOR CAR-BRAKES.—J. B. WRIGHT, Greensboro, N. C. This invention pertains to apparatus for automatically operating the brakes of a railway train in case of accident to the trucks or from any other cause which tends to throw the trucks into an abnormal position. The abnormal movement of the trucks in any direction will operate to set the brakes in an air brake system instantly and thereby stop the train.

METALLIC RAILROAD-TIE.—A. M. BAIRD, Topeka, Kan. The invention relates to ties such as shown and described in three Letters Patent of the U. S., formerly granted to Mr. Baird. The tie plate spans a channel plate, thus giving the desired flexibility to the tie, thereby permitting the latter to successfully withstand the heavy pounding incident to powerful high speed locomotives passing over rails held on the metallic tie.

TIE-JACK.—C. BERKNER, Litchfield, Minn. This jack is especially designed for use in lifting railroad ties and supporting the same beneath a rail during the spiking of the rail to the tie. The jack will enable one man instead of three as formerly to replace ties in their proper position on the railroad track, spike and tamp them.

Pertaining to Recreation.

GAME APPARATUS.—C. F. RENNER, Pittsburg, Pa. This game comprises a vessel for containing liquid, a gate arranged transversely of the vessel and provided with an opening, and a plurality of buoyant figures in the vessel and adapted to pass through the opening. It is entertaining, not altogether a game of chance and may be played by any number of players.

Pertaining to Vehicles.

SEAT-SECURING DEVICE FOR WAGONS.—C. W. RASMUS, Mount Union, Iowa. This improvement provides novel details of construction for a seat securing device, that may be readily connected with the body and seat of a wagon of the class of light freight wagons, each provided with an oblong box-like body having parallel sides, and afford convenient and reliable means for detachably securing the seat transversely on the wagon body.

CAR WHEEL AND AXLE.—B. L. WORTHEN, Tucson, Ariz. Ter. This invention relates to car wheels and axles for general use, and more particularly for service upon small cars used in mines and adapted to turn sharp curves. The wheels are provided with hubs and are loose upon the ends of the axle. Each hub has a ring-like enlarged portion which works in a recess in the framework, the wheel being by this arrangement prevented from leaving the shaft. The two wheels upon the same shaft thus turn independently. Provision is also made for lubricating both the axle and the wheels.

SYSTEM OF BRACING FOR TRACTION-ENGINES.—W. H. ENGLE, Tolstoy, S. D. This invention relates to systems of bracing for traction engines, and is particularly useful in connection with such vehicle or other structures having spaced frame members supporting mechanism tending to distort the frame members, or adapted to be unequally loaded whereby the frame members are liable to distortion.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12184) N. C. says: I maintain that a person at North Cape, Norway, on June 21st facing due north at midnight solar time will see the sun facing him. Supposing it possible for him to remain in such position twenty-four hours, at 6 A. M. sun will be at his right; at 12 M. (noon) at his back, his shadow pointing due north; at 6 P. M. at his left; and at midnight again, June 22d, facing him as before. The sun all the time is low in the heavens and in such position makes a complete circuit of the celestial sphere. In a conversation with a friend "who has been there," that is, to North Cape, he says that facing the sun at midnight on or about date mentioned, it would describe a comparatively small circle in the twenty-four hours and would always shine in the face of the observer provided he maintained his position facing the north. Will you kindly state which contention is the right one? A. We will state the case of the midnight sun on June 21st as seen from the North Cape, Norway. On June 21st the sun is vertically over the Tropic of Cancer. His declination changes but 2.2 seconds in that twenty-four hours; hence we may say that he is all day long threading the Tropic of Cancer. He is therefore 23 deg. 30 min. north of the Equator, and 66 deg. 30 min. from the North Pole all that day of twenty-four hours. The latitude of the North Cape is 71 deg. 10 min. 40 sec. N. Leaving the seconds out of the account, as also the effect of refraction for the present, we may say that the North Pole is 70 deg. 10 min. above the north point of the horizon of the North Cape, and the sun is 66 deg. 30 min. from the North Pole toward the north point of the horizon at midnight. The difference is 4 deg. 40 min., which is about nine diameters of the sun. At midnight on June 21st, from the North Cape, if you look to the north, if it is clear, you will see the sun about ten of its diameters above the horizon, since refraction will raise it apparently about a diameter. After midnight the sun swings on up toward the east, and keeps on a circle 66 deg. 30 min. from the North Pole as it goes. At noon then it will be to the south of the North Pole by the same distance, and it will be above the north points of the horizon by a distance equal to the sum of 71 deg. 10 min. and 66 deg. 30 min., or 137 deg. 40 min. This is 47 deg. 40 min. south of the zenith, or about half way from the zenith to the south point of the horizon. The writer of this has been to the North Cape and is describing what he has seen. The sun on June 21st does not describe a small circle about a point near the horizon as seen from the North Cape. It moves around the North Pole, as it does on all other days of every year, changing in its declination somewhat each day, so that in the winter half of the year of the northern hemisphere the sun is south of the equator, and in the summer half of the year it is north of the equator, but all the time the axis of the earth controls its apparent daily motion as seen from the earth. You are correct as to the motion of the sun over the sky to the east, south, and west during the day, but wrong in thinking that it will be low toward the horizon all day long, as we have shown above. Your friend is wrong in saying that the sun will describe a small circle. The circle is 6 deg. 30 min. radius. It is the smallest one which the sun describes, but all stars nearer the pole than 66 deg. 30 min. describe smaller circles than that, since all stars describe circles around the poles. The pole star describes a circle of 1 deg. 10 min. 45 sec. radius.

(12185) C. F. H. says: As I understand it, the earth's hour circles are 15 deg. apart and a degree is equal to 60 geographical miles. Now if the distance between each circle is 15 degrees, and as the hour circles converge toward the poles, the mileage or the number of degrees for each hour must vary. Which is it, and how is the mileage of each parallel figured? A. Your difficulty about the degrees and the miles of longitude arises from not remembering that a geographical mile is one-sixtieth of a degree of the earth's equator.

and not a sixtieth of a degree of longitude taken in any latitude one may please. A degree of longitude varies in length from the equator, where it is 60 miles long, to the pole, where it has no length. An hour is 15 degrees of longitude in every part of the earth, but not 900 miles. It is 15 times the number of miles the degree of longitude has in that latitude. The number of miles in a degree varies, and not the number of degrees in a circle. There are always 360 deg. in any circle, and always 24 hours in any circle of longitude; hence there are always 15 deg. in an hour, even close to the pole itself.

(12186) P. B. T. says: May I trespass upon your kindness to the extent of asking for a little scientific information regarding the horse-power of ocean surf waves? What I would like to know is: If the surf waves are 3 feet high, traveling 15 feet per second and arriving seven to the minute, and it were possible to intercept an area 40 feet wide by 10 feet deep, say 400 square feet, and entirely absorb the energy, what do you figure would be the total horse-power delivered by the seven waves—the interception being just outside the "breaking" line? Haswell gives some data under the head of "Waves of the Sea," but does not, I think, give any formula for ascertaining the horse-power. A. It is not quite clear from your question whether the 400 square feet area is intended to be in the vertical or the horizontal plane. In the former case no power would be generated, as the movement of the water in waves before they break is only in the vertical direction, a wave consisting only of upward and downward motion of a successive series of vertical sections of the water; in the latter case it cannot be calculated what proportion of the area rests at one time upon one wave. In the transactions of the American Society of Mechanical Engineers, vol. xiii, p. 428, Albert W. Stahl, U. S. N., gives the formula for the energy E of the whole wave length of a wave H feet high, L feet long, and 1 foot in breadth, the length being the distance between successive crests, and the height the vertical distance between crest and trough.

$$E = 8\ L\ H^2 (1 - 4.935 \frac{H^2}{L^2}) \text{ foot pounds.}$$

If N is the number of such waves per minute, the horse-power of a series of such waves per foot of breadth is

$$\frac{E \times N}{33{,}000} = 0.02339\ H^2\ L\ (1 - 4.935 \frac{H^2}{L^2})$$

(12187) M. P. V. says: If I am not asking too much, I would be pleased if you can help me out of trouble. I have a hot-water heating plant in the house which has twenty radiators. Seventeen radiators work O. K., but the other three will not. I have written to the makers, but they could not tell me the cause of the trouble. The three that cause trouble are at the end of the pipe, and branch from a cross; the cross is 1 inch, radiators' pipe ¾ inch, the main is 1¼ inch, and reduced at the cross. Two pipes from the cross go to radiators on the first floor, and the third pipe goes to the second floor. These three radiators return to a cross on the end of the return main. The pipes to the radiators on the first floor have a slight rise, and the one to the second floor is vertical. There are no air traps, and have had the pipes changed three times, but with the same result. The expansion tank is placed on the radiator pipe before the end where the cross is placed. 1. Does it make any difference where the expansion tank is connected to system? A. The position of the expansion tank should not theoretically make any difference in the operation of the system, but we think in your case that it would be better to place it beyond, i. e., farther away from the boiler than the crosses to which the last three radiators are connected. 2. Should the end of the two mains be connected with a pipe other than through the radiator? All the radiators work from where the expansion is connected back to the furnace, work O. K., but the three beyond this point will not work. A. There is no advantage to be gained by connecting the outflow of the return pipe otherwise than through the radiators. Such an arrangement, while probably increasing the average heat of the water in the pipes, would reduce the circulation of hot water through the radiators. The trouble is probably due merely to the three radiators in question being the most remote from the boiler; possibly also the expansion tank acts as a kind of hot-water storage reservoir and radiates a good deal of heat itself, so that the radiators farther on receive colder water than those between it and the boiler. We would suggest putting the tank on the return from the farthest radiator to the cross or on the return pipe from the cross to the boiler.

(12188) C. A. J. says: Take a standard ⅜-inch pipe nipple. Lock it in a pipe vise, 3 inches from one end. Screw on an extra heavy socket coupling, 1½-inch outside diameter, with a 12-inch wrench, as far as the socket will go. Question: If a man weighing 170 pounds bears his whole weight on the handle of the wrench, what is the twisting strain exerted on the ⅜-inch nipple? A. If a weight P acts at a distance a from the center of a shaft (or pipe) so as to twist it, the moment of the applied force is Pa. For your case the introduction of the thick coupling makes no theoretical difference, although in practice you get a better grip on account of the limitations of the tool. The force tending to twist the pipe acting on the fibers most remote from the axis of the pipe is to the force applied at the end of the wrench inversely as the distance of those fibers from the axis is to the length of the tool according to the law of levers. For example, if the weight of 170 pounds is applied 12 inches from the center of the pipe and the remotest fibers are 5/16 inch from the center, $P : 170 :: 12 : 5/16$, $P = 6.528$ pounds.

The twisting strain required to break the pipe calculated by the formula:

$$Pa = 0.1963 \frac{d^4 - d_1^4}{d} = S,$$

in which P equals the weight acting at a distance a from the center of the shaft or pipe, d equals the external and d_1 equals the internal diameter of the pipe, and S equals the unit shearing resistance of the material of the pipe. The latter may be taken as the same as the direct shearing resistance, say 45,000 pounds for wrought iron.

(12189) C. B. F. says: 1. Selective radiation, as I understand it, seems in defiance of the law that all bodies emit the same intensity of light at the same temperature. Kindly explain selective radiation. A. The fact is incontrovertible that bodies exert absorption of light and heat selectively, and hence also radiate selectively. This being established, it cannot be "in defiance" of any other law or fact. Laws do not thus defy each other in nature. Kirchoff showed that the emissive and absorbing powers of all bodies at the same temperature for a given color are proportional, when the radiation is a pure temperature effect. (Duff, "Physics," page 451, price $3.) But there are many substances whose luminosity is not a pure temperature effect. Considerable space is given to this topic in Barker's "Physics," which we send for $3.75 postpaid. 2. Where can I secure information concerning the telectroscope (electrical vision apparatus) of the Anderson brothers of Denmark, notice of which recently appeared in the Scientific American? A. We have no other information concerning the telectroscope than is given in the reference which you make. 3. Where can I secure a complete account of Tesla's experiments with high-tension currents? A. No complete account of Tesla's work with high potentials has been published. We can supply you with a small book with the title "Experiments at High Potentials" for $1, giving the principal part of the work.

(12190) J. R. asks: How does science explain the gyroscope phenomena? A. The gyroscope illustrates the persistency with which a rotating wheel resists any effort to twist its axle out of its position, or rather to turn the plane of the wheel out of its position. When the wheel is made very heavy and spun around very swiftly, it becomes very hard to turn it sidewise at all. Such a wheel is able to hold a car on a single rail from upsetting. This is the principle of the monorail car which has attracted so much attention recently. We published an illustrated description of this in three issues of the Scientific American, price 10 cents each mailed. We have published a number of articles regarding the theory of the motion of the gyroscope. You will find them in the Scientific American Supplement Nos. 1534, 1645, 1643 price ten cents each. We can also supply the following books: "Elementary Treatise on the Theory of Spinning Tops and Gyroscopic Motion," by Crabtree, price $1.50; also "Rotary Motion as Applied to the Gyroscope," by Barnard, price 50 cents.

(12191) J. M. asks: Can you tell me at what rate light travels? A. Light travels with a velocity of 186,000 miles a second. This has been measured with a good degree of accuracy by both Michelson and Newcomb separately at Washington. For their determinations see our Supplement Nos. 193 and 557, price ten cents each.

(12192) S. N. S. says: If you have the information in memory or conveniently accessible, please tell me the cost or approximate cost per mile of any part of our subway railways and any part of any two-track city trolley line, though I would rather have the approximate average cost of subways and trolleys (cost of line only; everything except rolling stock and power stations). A. It is very difficult to obtain exact figures for the cost of excavation of New York or other subway railways, and division of the total cost by the total length may make the cost per foot or mile very wide of the mark for any individual foot or even mile, on account of the great variation of ground and method. A general article on the New York subaqueous and subterranean railways in the April, 1907, number of the Engineering Magazine gives a good idea of the reasons for this discrepancy, or you could obtain a list of articles covering the subject from the Engineering News. With the great variety of subjects we have to cover we cannot keep statistics of any one subject so closely. The cost of the Pennsylvania Railroad improvements from Newark to Long Island City, including hard-rock tunneling under Manhattan, with low first cost of equipment but expensive in time and labor, and shield tunneling in silt under the rivers, rapid and cheap in execution but expensive in first cost of plant, would work out at about $2,000 a foot for a two-track subway. The included cost of the huge and costly terminal station is balanced by the comparatively low cost of several miles of embankment railroad only from Newark to Bergen Hill. The Brooklyn extension of the present subway, with smaller tunnel and no expensive stations but much the same variety of excavated ground, cost only about $300 a foot. Construction of ordinary city street railways would rarely approach a tenth of that figure. You will understand from the foregoing that these figures are the merest approximations.

(12193) R. W. says: I wish to get a solution of a problem which has puzzled me for some time. I understand that a horse-power is a definite thing. I have a small automobile whose engine is rated at 20 horse-power. The cylinders are 3¾ inches diameter by 4 inches stroke. I also have a four-cylinder marine engine whose cylinder diameter is 4¾ inches diameter and 5½ inches. Now both of these engines are rated at 20 horse-power. Would you be kind enough to show me why there is such a difference in size? A. You are correct that a horse-power represents a perfectly definite amount of work done in a given time, 550 foot-pounds per second or 33,000 per minute. Gasoline engine rating is however rather more arbitrary than that of steam engines and not always so closely related to test figures. In either case the number of foot-pounds of work done is the product of the piston speed by the mean effective pressure; and if your two engines have been accurately rated by their makers, and each gives approximately 20 brake horse-power, the only explanation is that the one with the larger diameter and stroke of cylinders must compress and also explode the gas to a lower pressure, or have a longer proportionate expansion, making the mean effective pressure less.

(12194) H. M. S. says: On November 29th I observed a star about two points north of east and about ten degrees above the horizon. This star as I watched it became alternately a bright red and a pale yellow. Can you explain this? A. The star which you observed is Aldebaran of the Constellation Taurus. The changes which you observed in its light and color are entirely atmospheric effects due to the slightly different paths which the rays take through the atmosphere. These changes are greater at some times than at others. They are wholly in the air, and not in the light of the star at all. 2. At the same time I also saw a very large and brilliant white star (or planet) about two points west of S. W. by W., and between twenty-five and thirty degrees above the horizon. Can you tell me what star it was? A. The bright object is the planet Venus, which is moving away from the sun to the east and so is our evening star in the western sky. Your estimate of its altitude is too large. Degrees near the horizon are deceptive, just as the apparent sizes of the sun and moon at rising are deceptive.

(12195) E. R. says: In 1900 Dewar obtained a temperature of —260 deg. C. by evaporating liquid hydrogen. Has a lower temperature been obtained since, and how? Is it possible to obtain a temperature below —273 deg. C.? A. Much has been done since 1900 in the production of low temperatures. In 1908 the last remaining gas was liquefied by Kamerlingh Onnes of Leyden, Holland. Helium, under a pressure of 100 atmospheres, was cooled in a bath of boiling hydrogen to —258 deg. C., the boiling point of hydrogen. Then it was still further cooled by the regenerative process, and liquefied. The boiling point of helium under atmospheric pressure is about —268.5 deg. C. By boiling it under a pressure of one centimeter of mercury the temperature is lowered to —270 deg., or 3 deg. above absolute zero. There is no substance known by which the cooling can be carried further, and there is little hope of reaching —273 deg., or absolute zero, by any means within our power.

(12196) P. T. says: Will you be kind enough to answer for us the following: If, for instance, a bricklayer's plumb bob was suspended in a vacuum and kept perpendicular, moving through space on the surface of the earth at a uniform speed of say 60 miles per hour, would the plumb bob show a true perpendicular or would it be slightly out, and if so would this be noticeable to the naked eye? A. A plummet would not deviate from a perpendicular by being in a vacuum. Gravity acts in a vacuum just as it does in the air. Nor would it be affected by a velocity of 50 miles per hour in a vacuum. It is going very much faster than that at present by the motion of the earth through space, at the enormous velocity of 18 miles a second. It is also moving with a velocity of 1,000 miles per hour on the equator by the eastward rotation of the earth upon its axis, and more than three-quarters as fast as that in the latitude of New York. Balls fall somewhat to the east of the point from which they are dropped, but this is due to another cause, the fact that they go from a level of more rapid to one of less rapid rotation of the earth. See Young's "General Astronomy," which we send for $3 postpaid.

(12197) C. J. H. says: A bets that the motorcycle has been driven to a higher speed than the automobile, and that the records show it. B bets that the automobile has been driven the faster. Who is right, and what is the record? A. In reply to your query, the automobile has made faster time than the motorcycle. Mariotti's mile on the Stanley steamer at Ormond Beach in 28 1/5 seconds (127.65 miles an hour) is, we believe, the record. G. H. Curtiss claimed he made a mile in 26 3/5 seconds on a 8-cylinder, 30 H. P. motorcycle of his own make at Ormond, but this was not official. The motorcycle record for a mile, 42 3/5 seconds, was made on a track by Fred Huyck.

(12198) A. W. S. says: We have trouble with resonance or echo in our church, which is very annoying. The audience room is about 70 feet long, by 40 feet wide. The speaker's desk is in the center of one side, in front of organ and choir. We are considering the matter of stretching a wire the length of the church at some distance from the speaker and in front of him. Will you kindly tell us if a wire would at all relieve the situation? Would several wires be more likely to relieve the trouble? How far relatively from speaker toward opposite wall should a wire or wires be placed, and how high? A. The echo in your church will not be remedied by one wire, nor perhaps by a large number of wires run across the room. The belief formerly was that a set of fine wires, so fine as to be nearly invisible, could be stretched across the room above the heads of the audience, perhaps ten feet from the floor, and that these would break up the sound waves. Hundreds of wires were thus used, ranging back through the room, at the same height, covering all the space. The best remedy for an echo is a full audience. Next, the hanging of loose curtains of soft materials on the walls. Prof. W. C. Sabine of Harvard University, Cambridge, Mass., has made many experiments in this matter. You will find an article upon his work in our Supplement No. 1772, which we will send for ten cents.

(12199) W. J. W. says: How cold would it be if it were twice as cold as zero? A great many answers have stated that it would be 230 deg. Fahrenheit below the Fahrenheit zero, working from the basis that that absolute zero Fahrenheit is 460 deg. below the Fahrenheit zero. A. Absolute zero is the temperature at which all heat would be removed from a body, or the temperature at which molecular motion would cease. From the observed fact that all gases contract 1/273 of their volume by cooling from zero Centigrade to one degree below zero, it is inferred that absolute zero is —273 deg. Centigrade, or 459.4 deg. Fahr. This is to be found in all the larger textbooks of physics. The degrees from absolute zero express the relative quantity of heat. Degrees of a thermometer do not give any idea of the relative quantity of heat, but only of relative temperature. The correct answer, if there be one, to the question, "How cold would it be if it were twice as cold as zero Fahrenheit?" is that it would be 229.7 deg. below zero. For the theory of gases on which the absolute zero is based see Carhart's "University Physics," vol. ii, page 29, etc.

(12200) H. B. says: Can you tell me whether a photograph has ever been sent by wireless telegraphy or whether it would be possible? A. We have never heard of sending a photograph by wireless telegraphy, and we are sure we do not know whether it is possible or not. He would be a rash man who would set the bound for the possible in this world of science.

(12201) A. G. asks: I have been trying to build a Wimshurst electrical machine as described in the Scientific American Supplement No. 48, but I have never been able to procure the brass balls to tip the rods and tubes with, that is, solid brass ball. I can get plenty of hollow brass balls. Would there be any kind of composition or filling a person could fill in the hollow brass that would answer the purpose, just as well as the solid brass? A. It is not necessary that the brass balls of a Wimshurst machine should be solid. They will work just as well if hollow, but they are not as strong as if solid. You may fill them with anything to make them stiff and strong. Even a wooden ball covered with tinfoil would serve the purpose, but to a less degree, since its surface would not be smooth. Only the surface of the metal on a static machine takes part in the electrical action of the machine.

(12202) W. M. asks: Can you supply me with a formula to meet the following case: It is desired to calculate the quantity of water delivered and height of jet from the nozzle of a fire hose when the following details are given, viz., head of pressure at fire engine or elevated tank, length and diameter of pipe, total fall, size of delivery nozzle. I have all the usual hydraulic formulas and tables giving flow of water in pipes and loss of head due to friction in pipe. From this latter cause (friction) it will be found that a moderately long pipe, say 1,000 feet, of moderate diameter, say 3 inches, having a head of 100 feet, will have all the head absorbed in friction, but in practice I actually get a moderately good fire stream through a 7/8-inch nozzle. It it understood that this result is obtained by the small orifice of nozzle delivering less quantity, and causing a reduced velocity of pipe, and therefore less loss of head; but I find no formula or rule whereby to work out the problem before described, viz., quantity delivered and height of jet. Books do not handle this special question. A. In further reply to your letter, the height of a jet of water thrown from a

fire-hose nozzle is calculated by the formula $h = KH$, in which h = the height of the jet in feet, H = the head of water in feet (or head corresponding to the pressure, 0.43 pounds to the square inch pressure = 1 foot head), and K = a coefficient varying with the ratio of the diameter of the jet to the head as follows:

If $H = d \times 300$	669	1000	1500	
$K =$	0.96	0.9	0.85	0.7
If $H = d \times 1800$		2800		3500
$K =$	0.6		0.5	0.25

For the case you mention your 100 feet of head = H, and $d = 7/8$ inch, so $H = 1370 \times d$ and the coefficient $k = 0.74$. The theoretical height of the jet should therefore be $0.74 \times 100 = 74$ feet. The head H must be corrected, however, by the friction in pipe and hose. The loss of pressure or its equivalent loss of head may be calculated by the formula $h = v^2 (4m) \frac{l}{2gd}$, in which the constants are d = 3 inches diameter of pipe (in your case) = 0.25 foot, l = length of pipe = 100 feet, and $2g = 62.4$; and the variables are v = velocity of water in feet per second, h = loss of head per 100 feet of pipe, and m = a coefficient found by experiment. The velocity v must be calculated from the measured discharge of a given pipe, i. e., the cubic feet of water discharged per second by the sectional area of the hose. The coefficient m varies from 0.0045 for a discharge of 200 gallons per minute or a velocity of 13.07 feet per second in a 2½-inch pipe to 0.00452 for 500 gallons per minute or 32.67 feet per second in a 2½-inch hose. A simpler but less closely approximate formula for loss of head is $h = \frac{lg^2}{1801d^5}$, in which h is loss of head in feet as before, l = length of pipe in feet, g = quantity of water discharged in gallons per minute, and d = diameter of hose in inches. We regret that we cannot conclude the calculation for you as you do not mention the quantity discharged, which prevents our arriving at the values of v and m in the second formula or q in the third, but from your discussion of the subject we have no doubt that with the above particulars you will easily be able to calculate the height of the jet yourself.

NEW BOOKS, ETC.

ELEMENTS OF MACHINE DESIGN. By Dexter S. Kimball, A.B., and John H. Barr, M.S., M.M.E. New York: John Wiley & Sons, 1909. 8vo.; pp. 446; 196 cuts. Price, $3.

This work is the outgrowth of the experience of the authors in teaching machine design at Cornell University. The first three chapters are introductory, taking up the fundamental principles of machine design, a brief discussion of energy and force problems, and the more important straining actions, with formulas for strength and stiffness. Chapter IV takes up lubrication and efficiency, while the remainder of the book deals with important machine details illustrating the application in practice of the theoretical considerations discussed in the first part of the book.

DIRECT AND ALTERNATING CURRENT TESTING. By Frederick Bedell, Ph.D, assisted by Clarence D. Pierce, Ph.D. New York: D. Van Nostrand Company, 1909. 8vo.; pp. 265. Price, $2.

This work has been prepared primarily for students, although it will doubtless be found helpful to others. It consists of a series of tests on direct and alternating current apparatus, which are explained in such a manner that the reader's attention is directed to the principles underlying the experiments and the significance of the results. Such tests as require special apparatus or unusual testing facilities are left out of the text proper, though they are described in the appendices to the various experiments.

LESSONS IN TELEGRAPHY. By Charles Henry Sewall. New York: D. Van Nostrand Company, 1909. 12mo.; pp. 88. Price, $1.

The book is intended as a textbook for schools and colleges and is intended to furnish the student not only with the ordinary instructions necessary to learn the art of telegraphy, but also takes up the negative side of the study, telling the student what not to do, and thereby preventing him from forming bad habits which might be difficult to remedy later on.

RADIATION, LIGHT, AND ILLUMINATION. Series of engineering lectures delivered by Charles Proteus Steinmetz, A.M., Ph.D., compiled and edited by Joseph Le Roy Hayden. New York: McGraw-Hill Book Company, 1909. 8vo.; pp. 305; 127 cuts. Price, $3.

These lectures by Professor Steinmetz before the students in electrical engineering at Union University have been compiled not only to provide a textbook of illuminating engineering, but also to provide the public at large with a knowledge of light and radiation. For this reason mathematics have been avoided in all the lectures except two, which by their nature are mathematical and are intended for the illuminating engineer. However, the general reader who has little knowledge of mathematics may avoid these two chapters without serious loss.

COLLEGE ALGEBRA. By H. L. Rietz, Ph.D., and A. R. Crathorne, Ph.D. New York: Henry Holt & Company, 1909. 12mo.; pp. 261. Price, $1.40.

Recognizing the fact that a considerable period of time elapses in most cases between the completion of the high school algebra and the beginning of college mathematics, the authors have devoted the first part of the textbook to a review of high school algebra. At the same time new matter is introduced which his added maturity enables him to appreciate. In treating the more advanced portion of the subject many topics usually found in textbooks and college textbooks are omitted and the matter is restricted to the development of those central points which the experience of the authors has shown to be essential.

ALTERNATING CURRENT MOTORS. By A. S. McAllister, Ph.D. Third edition. New York: McGraw-Hill Book Company, 1909. Pp. 322, 138 figures. Price, $3.

The present edition has been enlarged and revised, and takes up the recently developed "split pole" variable-ratio synchronous convertor and contains a chapter on synchronous motors, in which the characteristics of this machine as a motor and as a "condenser" are fully treated. The chapter on prevention of sparking in single-phase commutator motors includes the latest improvements in commutating-pole motors.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING. By Charles Proteus Steinmetz, A.M., Ph.D. Third edition. New York: McGraw-Hill Book Company, 1909. Pp. 455, 239 illustrations. Price, $4.

The present work is in a certain respect supplementary to "Alternating Current Phenomena," and contains specific discussion of the different features of individual apparatus, presenting the most important electrical apparatus and their action under normal and abnormal conditions. The first edition, which was published eight years ago, is now revised and much enlarged, so as to bring it up to date in theory and practice. The author recommends that this book be read in parallel with the first seventeen chapters of "Theory and Calculation of Alternating Current Phenomena," as in this way a clear insight into the nature and behavior of the apparatus will be obtained.

DYNAMO LABORATORY MANUAL FOR COLLEGES AND TECHNICAL SCHOOLS. Vol. I. Direct-Current Studies and Tests by William Suddards Franklin, with the co-operation of Stanley S. Seyfert, and Clarence E. Clewell. New York: The Macmillan Company, 1909. 12mo.; pp. 152. Price, $1.75.

The authors describe a series of laboratory experiments for students, many of which are chosen primarily for their educational value, while others are such as are sometimes carried out in practice. The directions are very complete and practical, and the authors suggest that the students be thrown upon their own resources in performing the experimental work, so that they will become accustomed to translating scientific writing into ideas of reality, and also develop manual dexterity.

ASTRONOMY FROM A DIPPER. By Elliot C. Clarke. Boston and New York: Houghton, Mifflin Company, 1909. Pp. 66. Price, 60 cents.

The object of this book is to acquaint the amateur with the positions of the constellations and the names of the principal stars. The Great Dipper is used as the spot from which the various constellations are pointed out, hence the odd title of the book. The subject is considered in a semi-humorous vein and the object is well carried out by the author, who claims that because he knows but little more than his readers he is for this reason eminently fitted to be their teacher.

ELECTRIC RAILWAY TROUBLES AND HOW TO FIND THEM. By Paul E. Lowe, M.E. Chicago: Frederick J. Drake & Co., 1909. 12mo.; pp. 367, 118 figures. Price, $1.50.

This is a book for motormen and is designed to acquaint them with the mechanism of their cars and enable them to make their own repairs in emergencies. Their author aims to avoid complication and endeavors to explain everything in the simplest terms possible and in a thoroughly practical manner. In order that the motorman may fix the matter in his memory, a "Repair Catechism" is included in the book, which contains 169 questions and answers.

COMPRESSED AIR. By Lucius I. Wightman, E.E. Chicago: American School of Correspondence, 1909. Large 8vo.; pp. 168.

This is a reference work on the production, transmission, and application of compressed air; the selection, operation, and maintenance of compressed air machinery; and the design of air power plants. Compressed air and electricity to-day share between them the great field of power transmission, to the practical exclusion of all other transmission agents. Steam, because of its rapid condensation, can hardly be considered as a practical power transmitter for any but the shortest distances. Hydraulic transmission has had no general application. Mechanical means of transmission, such as shafts, belts, ropes, chains, and gears, are necessarily very limited in their possibilities. Compressed air and electricity, on the contrary, offer almost unlimited possibilities of extension and of diversified application; and in all cases, where properly applied, they are entirely successful when measured by the modern standards of commercial economy. With the relative merits or shortcomings of compressed air and electricity as power-transmitting agents, the work has nothing to do. Modern engineering has defined, with reasonable clearness, the respective fields of these agents, into either of which the other agent cannot hope to enter with any degree of success. The rivalry of the earlier days between these two forms of power transmission has given place to a mutual recognition of one another's merits and cordial co-operation in certain classes of work for which neither alone is fully adapted. The illustrations are numerous.

WOOD PRODUCTS, DISTILLATES, AND EXTRACTS. By P. Dumesny and J. Snoir. Translated from the French by Donald Green. London: Scott, Greenwood & Co., 1908. New York: D. Van Nostrand & Co. 8vo.; pp. 320. Price, $4.50.

The literature on wood products which are obtained by distillation and extraction is very limited, so that the present volume will be warmly welcome. The work is divided into two parts, the first dealing with the chemical products of wood distillation, and the second with dyeing and tanning extracts obtained from wood. The chapters deal with the principal method of distilling wood; the acetic acid industry; the secondary products of wood distillation; the analysis of raw materials and finished products; the extraction of extracts, etc., for tanning and other purposes. The work is well illustrated by appropriate engravings.

THE PROBLEM OF EVIL. A Criticism of the Augustinian Point of View. By Marion Leroy Burton, B.D., Ph.D. Chicago: The Open Court Publishing Company, 1909. 12mo.; 234 pp. Price, $1.25.

The readers of this book are warned at the outset that the work is not intended for the popular reader, but is a detailed technical criticism of the philosophical basis of the Augustinian treatment of the problem of evil. The last chapter, however, summarizes the conclusions of the author, and may be taken up with interest by those who do not care to delve into the arguments by which the author has arrived at his position. A partial list of Augustine's own works and such other books as the author has found useful in preparing his criticism is given.

THE APOCRYPHAL ACTS OF PAUL, PETER, JOHN, ANDREW, AND THOMAS. By Bernard Pick. Chicago: The Open Court Publishing Company, 1909. 12mo.; 376 pp. Price, $1.25.

The present work is the first attempt to make the researches of Lipsius and Bonnet on the Apocryphal Acts of the Apostles and Schmidt's Cotpic Acta Pauli accessible to the English reader. Only the older and more important Acts are taken up in the present volume. Although these Acts contain both truth and fiction, they are of importance as giving us a picture of Christianity toward the end of the second century, and form an important contribution to the primitive literature of the Church. The text is accompanied by copious notes, particularly that part dealing with the Acts of Paul.

STAR GAZER'S HAND BOOK. A Brief Guide for Amateur Students of Astronomy. By Henry W. Ellson, Ph.D. New York: Sturgis & Walton Company, 1909. 16mo.; 55 pp.; 4 plates. Price, 50 cents.

The author, who has presented the subject of astronomy at teachers' institutes and similar gatherings, has compiled the present handbook at the special request of a number of teachers. In a very condensed form and without the use of mathematics, the main astronomical facts are given. The constellations are dealt with in particular, with the mythological stories relating to them.

CASTLES AND CHATEAUX OF OLD BURGUNDY AND BORDER PROVINCES. By Francis Miltoun. Boston: L. C. Page & Co., 1909. 12mo.; 333 pp. Price, $3.

The old Burgundian Province was closely allied topographically, climatically, and by ties of family with many of its neighboring political divisions, and it is for this reason that this section of France is of particular interest. Not in the royal domain of France itself, not in luxurious Touraine, were there more of splendor and the costly trappings of the ceremonial of the Middle Ages than in Burgundy, which has ever been a land of prosperity and plenty. To the traveler in France this section of the country affords particular advantages; access is easy, owing to good means of communication by a network of railroads. The author has presented the subject in a most interesting manner, and the illustrations by Blanche McManus are reproduced from paintings made upon the spot. The book is handsomely printed and bound, and is most luxurious.

THE WONDERS OF ASIATIC EXPLORATION. By Archibald William, B.A., F.R.G.S. Philadelphia: J. B. Lippincott, 1910. 12mo.; pp. 159. Price, 75 cents.

The titles of the chapters of this interesting book are as follows: Four Years in the Wilds of Asia; Further Adventures in Eastern Turkestan and Tibet; Surveying in Mid-Asia; Lhasa Visited; From Manchuria to the Pamirs; An Adventurous Journey Among Celestials and Lamas; The Strange People of the East Indian Archipelago; The Unexplored Peaks of New Guinea. The contents of this book have been taken from Mr. Archibald Williams's larger book entitled "The Romance of Modern Exploration," and a chapter on Exploration in New Guinea by Mr. Norman Davidson has been added. The book is a very timely one, giving the very latest information available.

THE WONDERS OF ANIMAL INGENUITY. By H. Coupin, D.Sc., and John Lea, M.A. Philadelphia: J. B. Lippincott Company, 1910. 12mo.; pp. 163. Price, 75 cents.

This attractive book deals with some of the wonderful activities of the animal world. The first chapter deals with "Master Craftsmen," the second and third chapters, with "Excavators and Miners"; then comes a chapter on "Makers of Baskets"; then one on "Architects of Spherical Dwellings"; then there comes a chapter on "Makers of Mounds—Ants." This is followed by the "Mounds Made by Birds"; then come two chapters on "Masons." An entirely new concept of the animal world is obtained by a perusal of this fascinating book, which has an extremely ugly cover.

MAKERS OF ELECTRICITY. By Brother Potamian, F.S.C., D.Sc. Lond., Professor of Physics in Manhattan College, N. Y., and James J. Walsh, M.D., Ph.D., LL.D., Dean and Professor of Nervous Diseases and of the History of Medicine at Fordham University School of Medicine; Professor of Physiological Psychology at the Cathedral College, New York. New York: Fordham University Press, 1909. pp. 404.

Dr. James J. Walsh, who with Brother Potamian, presents this new series of biographies, attracted not a little attention in literary and scientific circles with his "Makers of Modern Medicine," and "The Popes and Science," in which books he discussed ardently and, it must be confessed, with justice, the valuable scientific contributions made by that very Catholic clergy of the Middle Ages which is popularly supposed to have done all in its power to prevent the spread of learning. In the volume before us we have no systematic attempt to thwart the purposes of biography by fostering those of religion, although it is distinctly pointed out in the preface that every one of the men whose lives are discussed, from Peregrinus and Columbus to Lord Kelvin, were all of them men of deep religious convictions. On the whole, one will find in this book very good sketches of the lives of the great pioneers in electricity with a clear presentation of how it was that these men came to make their fundamental experiments and how we now reach conclusions in science that would have been impossible until their work of revealing was done. The biographies published are those of Peregrinus, Columbus, Norman and Gilbert, Franklin and some contemporaries, Galvani, Volta, Coulomb, Oersted, Ampère, Ohm, Faraday, Clerk, Maxwell and Kelvin.

POWER, HEATING AND VENTILATION. A Treatise for Designing and Constructing Engineers, Architects and Students. By Charles L. Hubbard, B.S., M.E. Part I., Boiler Room Equipment; first edition. Brattleboro, Vt.: The Technical Press, 1908. 8vo.; pp. 216. Price, $2.

The matter contained in this volume had its beginning in a pocket note book, which in turn served as a basis for articles which appeared in the Technical Press from time to time. Occasional calls for reprints of these articles led the author to select those having the most practical value, and to combine with them others to form sufficiently new material to make up a treatise on power and heating plants. The subject of power is treated more especially from the steam side, but there is also reference to the requirements of electric lighting and the distribution of electric power. No attempt has been made to cover central station work, but plants similar to those found in factories, office buildings and institutions. The illustrations are excellent, the wax process being used exclusively.

COLLEGE TEXT BOOK OF GEOLOGY. By Thomas C. Chamberlin and Rollin D. Salisbury. New York: Henry Holt & Co., 1909. 12mo.; pp. 978. Price, $3.50 net.

For a number of years there has been room for a thoroughly modern work on geology which can be used as a text book. At last we have an ideal book, a perusal of which will benefit anyone whether he is interested in the subject or not. He certainly will be after he has finished a few of the chapters. The book is elaborately illustrated with 608 engravings and a considerable number of plates, many of them in color. The illustrations in nearly every case are made from original photographs and are a great relief from the time-honored illustrations which one is wont to see in his geology. In brief the book is divided into two parts: first, Dynamic and Structural Geology; second, Historical Geology. Under the first part, the materials of the earth and their arrangement. The Geological Work of the Atmosphere, Land Waters,

Ground (Underground) Water, The Work of Snow and Ice, The Work of the Ocean, Lakes, Movements and Deformations of the Earth's Body, Vulcanism, and Structural Geology. In the second part we have: The Origin of the Earth, The Archeozoic Era, The Proterozoic Era, The Paleozoic Era, which is in turn divided into the Cambrian Period, The Lower Silurian, The Upper Silurian, The Devonian, the Mississippian, the Pennsylvanian, the Permian Period. We then come to the Mesozoic Era which is divided into the Triassic Period, the Jurassic Period, the Cretaceous Period. Now comes the Cenozoic Era, which is divided into the Eocene Period, the Miocene Period, the Pliocene Period, the pleistocene or Glacial Period, and the Human or Present Period. A perusal of this work will give the reader an excellent idea of the whole subject.

A HANDBOOK OF POLAR DISCOVERIES. By A. W. Greely, Major-General United States Army. Fourth Edition, Revised and Enlarged. Boston: Little, Brown & Company, 1909. pp. 336. Price, $1.50.

Major-General Greely, himself an Arctic explorer of distinction, has performed a notable service in gathering in an authoritative handbook records of the principal expeditions made from the time of the early northwest voyages down to the year of 1909. In view of the Cook-Peary controversy, naturally one turns with some curiosity to those chapters of the book in which the claims of Cook and Peary would necessarily be discussed. General Greely "finds himself constrained to give full credit" to both, notwithstanding the sharp attacks which have been made upon the former. Of his own courageous explorations he writes with characteristic modesty and yet as fully as the historical value of his work demands. General Greely's volume represents more than 70,000 pages of narrative, from which he has endeavored to compile such data of accomplished results as may subserve the inquiries of the busy man who often wishes to know what, when, and where, rather than how.

MENDEL'S PRINCIPLES OF HEREDITY. By W. Bateson, M.A., F.R.S., V.M.H., Fellow of St. John's College, Professor of Biology in the University of Cambridge. Cambridge, at the University Press. New York: G. P. Putnam's Sons, 1909. pp. 396.

Mr. Bateson is well known to students of biology as an authority on breeding and heredity. In the present volume he has given a succinct account of the discoveries which have been made by the practical application of Mendel's method of research. As a result of Mendel's work and its application by modern biologists in which task Mr. Bateson himself has played no small part, the study of heredity has become an organized branch of physiological science, already abundant in results and in promise. Although the subject is by no means exhaustive, still at the present time our knowledge of the facts has reached a definite stage, and a book in which the phenomena of heredity are scientifically presented is certainly needed. Such a book Mr. Bateson has presented, and presented moreover very ably when it is considered how diverse and many are the facts, zoological and botanical, from which the material must be drawn.

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AND EACH BEARING THAT DATE

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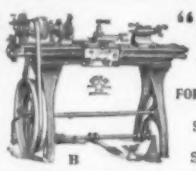

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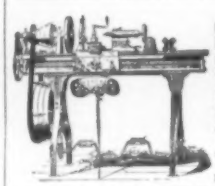

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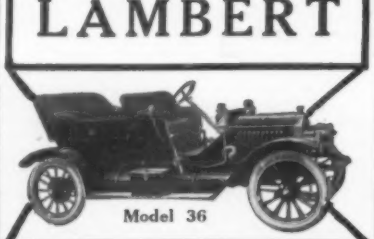

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(*Continued from page 120.*)

mobiles and electric trucks. So far they have failed to develop any serious difficulties. It took the utmost patience on the part of Mr. Edison to develop the battery to a state which he now considers practically "fool-proof." Naturally the public has not been so patient and has been grumbling about the long delay in developing this battery concerning which so much has been promised.

The other day the public was invited to inspect a street railway car equipped with the new batteries, which was run on a short section of track in West Orange. This car differs materially from the ordinary car not only in the power source, but in general design. The amount of current to be stored in the battery is limited, and in order to make this power go as far as possible it was essential that all superfluous weight be eliminated. The question of weight is not so vital a matter in the ordinary street car and has never received a great deal of attention. Mr. Ralph A. Beach, who has been Mr. Edison's assistant in adapting the storage battery to traction, was called upon to build a special car that would be as light as possible. He found that the common street car is merely a smaller and slightly modified steam railroad car, and it was necessary for him to branch out on entirely new lines. He guarded as jealously against unnecessary weight as the builder of an aeroplane. The backbone of the car he evolved consists of two 18-foot lattice girders which extend the entire length of the body under the seats. They consist of electrically welded steel bars and are so inflexible that when loaded with two tons at the center they show a deflection of but 3/1000 of an inch. Around these two girders the car is built. In the first place they form a casing to receive the batteries of which there are 210 cells, 100 on each side for power and 10 for lighting. All the superstructure of the car is built of veneer and light woodwork with the exception of the strap rails and posts, which are of bicycle tubing and act as a framework to support the weight of the roof. The roof itself consists of a single sheet of veneer bent to the proper form, and is so light as to permit of making the side posts much smaller than in the ordinary car. The fact that this car does not have to support a trolley pole has allowed of using so light a roof.

The truck contains many novel features. The connection between the truck and body is such as to permit of a side and end movement of but ⅛ of an inch, although it may move vertically to a much greater degree. The object of this is to insure smooth running and to prevent the usual swaying. In place of the usual car wheels light steel wheels are used. The axles are divided at the center, being connected by long sleeves which permit one wheel to gain upon its mate when rounding curves or in case of a slight difference in their diameter. In this arrangement will be seen the influence of the automobile. There are other features as well which remind one of the automobile and show a radical departure from the common car construction. In place of gearing the motors directly to the wheels a silent chain drive is used which, as automobile practice has shown, furnishes a more economical transmission owing to the fact that a large part of the sprocket wheels is in mesh with the chain, whereas in the spur gear transmission only one tooth, or at most, three teeth of the pinion, can engage the teeth of the gear. Furthermore the chain drive permits of a greater gear reduction. Commonly a 3 to 1 reduction is the most used on railway cars, whereas on the storage battery car a reduction of 6 to 1 is employed. This permits of using lighter motors, and hence forms one of the principal reasons why a chain gear was adopted.

The car is equipped with two 5-horsepower 110-volt motors which are of a very light construction. During the recent tests the car maintained a maximum

(*Continued on page 133.*)

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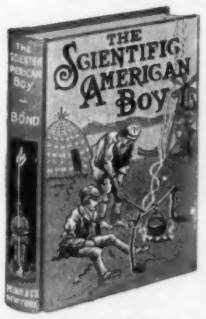

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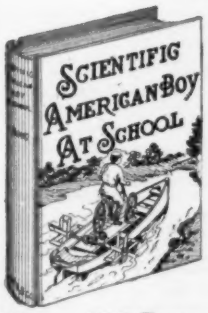

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(Continued from page 132.)

speed of 15 miles per hour. The total weight of the car is estimated at 5 tons, and will seat 26 passengers, whereas the ordinary street car of the same size weighs twice that amount. The battery weighs 2,700 pounds, the car body 3,500, and the truck complete 3,800 pounds. It is claimed that the capacity of the batteries is sufficient to run the car continuously for 150 miles, although in regular street traffic, where a car is obliged to stop and start and crawl behind trucks, a single charge would probably carry the car but half this distance. The car is to be tested on West Street, in this city, where an excellent opportunity will be given it to demonstrate its efficiency for regular street service, not only as regards the battery, but the light car construction as well.

ARTIFICIAL PRODUCTION OF THE VOICE.

(Concluded from page 120.)

emitted by the larynx were recorded by a phonograph. The following conclusions were reached:

When the larynx of a dog is removed during chloroform ansethesia, the laryngeal muscles retain their ability to contract for a short period, which varies from 3 to 10 minutes, but no contraction can be produced in the muscles of a dead larynx, even if it is removed immediately after the death of the animal, because the arterial blood has escaped. In order to produce the vibrations, the current of air should be impelled by a pressure of from 6 to 8 inches of water, as it is in the normal production of the human voice. In these conditions the excised larynx of the dog barks and howls in every note of the canine register, from the deep baying of a mastiff to the shrill pipe of a terrier. These various notes are obtained at will by causing various muscles to contract. If the stimulation is confined to the muscles which connect the two arytenoid cartilages (two small cartilages at the back of the larynx, to which the posterior ends of the vocal cords are attached) these cartilages approach each other and a deep tone is produced. If, on the other hand, the stimulation is extended to the muscles which connect the arytenoid cartilages with the thyroid cartilage (the large V-shaped cartilage at the front of the larynx, constituting the "Adam's apple," to which the anterior ends of the vocal cords are attached), the vocal cords are contracted and a high, shrill note results.

The pitch of the note appears to be independent of the pressure of the air and the strength of the electric current, and to be determined solely by the part of the muscular system of the larynx to which the stimulation is applied. The whole larynx, including the glottis and the epiglottis, changes its form with every change in pitch. Hence the larynx is a musical instrument which produces various notes by changing its form and dimensions.

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(Continued from page 125.)

tilizer, etc., that modern scientific research has proved to be correct. He was arrested as a heretic in 1588 and immured in the Bastile, but in 1590, before his case had been disposed of, he died.

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(Concluded on page 135.)

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(*Concluded from page 133.*)

he is very completely represented by important specimens showing the three distinct styles that he adopted in the course of the development of his art. His first dishes were usually oval in form, decorated in the center and at the edges with animals, modeled after nature, fish, frogs, snakes, shells and shell-fish, reposing on flowered moss, or swimming in streams of transparent water; at the back enamel marbled in yellow, green, and red. In his second style Palissy partly abandoned the rustic decoration of his pieces; he retained only the shells as a framing and gave to the central subject the chief importance. Finally, in his third style, he abandoned the rustic completely and used only the marbled enamel as a poly-chrome attraction. The modeled figures then became very important and sometimes he reproduced, in poly-chrome pottery, the pewter vessels of the then celebrated Briot, such as the famous piece which represents the "triumph of temperance," of which an illustration is here presented, and he modeled in miniature sculpture and afterward colored and enameled a very diversified series of small articles, nurses, hurdy-gurdy and bagpipe players, etc.

We produce herewith a portrait of Bernard Palissy from an old French miniature of his period on vellum, that is oreserved at the Cluny Museum. Palissy is represented, full face and in court costume with ruffs. His doublet is embroidered and relieved with gold, the sleeves are be-ribboned, and on the chest is braid. Above the head appears the inscription: B. Palissy.

His works reflect alike genius and artistic taste, and his work was original, marvelously true to nature in execution and coloring, and probably in a more marked degree than any other master of the ceramic art, he learned to perfect colors that would be, after firing, known quantities, a knowledge that enabled him to duplicate, with such wonderful certainty, the color effects of the fish, reptiles, insects, etc., he loved to reproduce. The extent to which his style was imitated affords the most practical proof of the favor it enjoyed.

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Trolley wheel, G. H. Downs	947,436, 947,758, 947,759
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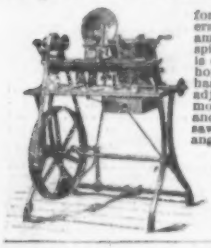

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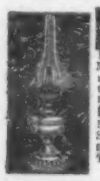

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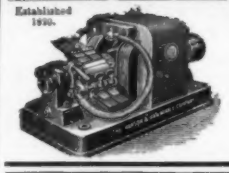

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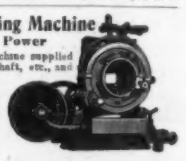

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